Zeal Education Society's

ZEAL COLLEGE OF ENGINEERING & RESEARCH, PUNE – 41

(An Autonomous Institute Affiliated to Savitribai Phule Pune University)

*NAAC Accredited with **A+** Grade / ISO 21001:2018*

DEPARTMENT OF ROBOTICS AND AUTOMATION

Curriculum Structure and Syllabus of

S.Y. B. Tech. – Robotics and Automation

(With effect from - Academic Year 2026- 27)

VISION OF THE INSTITUTE

To be a premier institute in technical education by imparting academic excellence, research, social and entrepreneurial attitude.

MISSION OF THE INSTITUTE

- To achieve academic excellence through innovative teaching and learning process.
- To imbibe the research culture for addressing industry and societal needs.
- To inculcate social attitude through community engagement initiatives.
- To provide conducive environment for building the entrepreneurial skills.

DEPARTMENT OF ROBOTICS AND AUTOMATION

VISION:

To be recognized as a multidisciplinary department and build skilled professionals by imparting quality technical education and inculcating problem solving and lifelong learning skills through project-based approach in collaboration with industries in the field of Robotics & Automation.

MISSION:

M1: To impart quality technical education in Robotics and Automation Engineering.
M2: To inculcate sustainable skills in automation technologies, research and learning attitudes, and social responsibilities.
M3: To be committed to fulfill the needs of society in the Robotics & Automation industries.

PROGRAM EDUCATIONAL OBJECTIVES (PEOs):

PEO1: Robotics & Automation Engineering graduates excel in solving industrial challenges, innovating for society, and leveraging core engineering principles for industry advancement.
PEO2: Graduates will apply technical expertise, leadership, and entrepreneurship, to establish ethical organizations to address societal needs and pursue higher studies.
PEO3: Graduates will work effectively as individuals and as team members with high ethical values and motivation for life-long learning for the benefit of society.

PROGRAM OUTCOMES (POs):

PO1: Engineering knowledge: Apply knowledge of mathematics, natural science, computing, engineering fundamentals and an engineering specialization as specified in WK1 to WK4 respectively to develop to the solution of complex engineering problems.
PO2: Problem analysis: Identify, formulate, review research literature and analyze complex engineering problems reaching substantiated conclusions with consideration for sustainable development. (WK1 to WK4).
PO3: Design/development of solutions: Design creative solutions for complex engineering problems and design/develop systems/components/processes to meet identified needs with consideration for the public health and safety, whole-life cost, net zero carbon, culture, society and environment as required. (WK5)
PO4: Conduct investigations of complex problems: Conduct investigations of complex engineering problems using research-based knowledge including design of experiments, modelling, analysis & interpretation of data to provide valid conclusions. (WK8).
PO5: Engineering Tool Usage: Create, select and apply appropriate techniques, resources and modern engineering & IT tools, including prediction and modelling recognizing their limitations to solve complex engineering problems. (WK2 and WK6).

PO6: The Engineer and Word: Analyze and evaluate societal and environmental aspects while solving complex engineering problems for its impact on sustainability with reference to economy, health, safety, legal framework, culture and environment. (WK1, WK5, and WK7).

PO7: Ethics: Apply ethical principles and commit to professional ethics, human values, diversity and inclusion; adhere to national & international laws. (WK9).

PO8: Individual and team work: Function effectively as an individual, and as a member or leader in diverse/multi-disciplinary teams.

PO9: Communication: Communicate effectively and inclusively within the engineering community and society at large, such as being able to comprehend and write effective reports and design documentation, make effective presentations considering cultural, language, and learning differences.

PO10: Project Management and Finance: Apply knowledge and understanding of engineering management principles and economic decision-making and apply these to one's own work, as a member and leader in a team, and to manage projects and in multidisciplinary environments.

PO11: Life-long learning: Recognize the need for, and have the preparation and ability for i) independent and life-long learning ii) adaptability to new and emerging technologies and iii) critical thinking in the broadest context of technological change. (WK8).

PROGRAM SPECIFIC OUTCOMES (PSOs):

PSO1: Design and Development of robotic systems that are cost-effective, environment friendly to solve engineering and societal problems using advanced tools and techniques.

PSO2: Model, program and build an error-free, safe, and productive automation systems for various manufacturing processes.

PSO3: Apply domain knowledge of robotics and automation to provide solutions in interdisciplinary areas to meet current industrial challenges.

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LIST OF ABBREVIATIONS

Abbreviation	Description
BSC	Basic Science Course
ESC	Engineering Science Course
PCC	Program Core Course
PEC	Program Elective Course
MDM	Multidisciplinary Minor
OE	Open Elective - Other than a particular program
VSEC	Vocational and Skill Enhancement Course
AEC	Ability Enhancement Course
ENTR	Entrepreneurship
EC	Economics
MC	Management Courses
IKS	Indian Knowledge System
VEC	Value Education Courses
RM	Research Methodology
CEP	Community Engagement Project
FP	Field Project
PROJ	Project
INT	Internship
OJT	On Job Training
CC	Co-curricular Courses
HSSM	Humanities Social Science and Management
ELC	Experiential Learning Course
B. Tech	Bachelor of Technology
L	Lecture
P	Practical
T	Tutorial
H	Hours
CR	Credits
CIE	Continuous Internal Evaluation
ETE	End Term Evaluation
TW	Term Work
OR	Oral
PR	Project

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Second Year B. Tech. – Robotics & Automation: Semester - III

Course Code	Course Type	Course Name	Teaching Scheme (Hrs./Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/ Tut	Total						
25RAPC302	PCC	Structural Mechanics for Robotic Applications	4	-	-	4	4	-	4	40	60	-	-	-	100
25RAPC302P	PCC	Structural Mechanics for Robotic Applications Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25RAPC303	PCC	Electrical Machines & Drives	3	-	-	3	3	-	3	40	60	-	-	-	100
25RAPC303P	PCC	Electrical Machines & Drives Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25RAPC304	PCC	Smart Materials & MEMS	3	-	-	3	3	-	3	40	60	-	-	-	100
25RAMD301	MDM	Engineering Mathematics III	3	-	-	3	3	-	3	40	60	-	-	-	100
25ALOE301	OE	Open Elective – I #	2	-	-	2	2	-	2	-	-	50	-	50	100
25RAVS304	VSEC	Problem Solving Techniques- I	-	2	-	2	-	1	1	-	-	25	-	-	25
25RAVS305	VSEC	Programming in C/C++	-	2	-	2	-	1	1	-	-	-	50	-	50
25RACE301	CEP	Project Based Learning	-	2	-	2	-	1	1	-	-	25	-	-	25
25RACC305	CC	Liberal Learning III	-	2	-	2	-	1	1	-	-	25	-	-	25
25RAIN301	ELC -INT	Internship-I*	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**15**	**12**	**-**	**27**	**15**	**08**	**23**	**160**	**240**	**150**	**50**	**100**	**700**

# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - I**
25ALOE301A	OEC	Digital Literacy and Applications
25ALOE301B		Environmental Studies
25ALOE301C		Green Energy and Sustainability
25ALOE301D		Basics of Consumer Electronics
25ALOE301E		Renewable Energy Systems

BoS Chairman

ZES's Zeal College of Engineering & Research PU/PN/Engg./285/2007 Narhe, Pune-41

Director

ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

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Second Year B. Tech. – Robotics & Automation: Semester - IV

Course Code	Course Type	Course Name	Teaching Scheme (Hrs./Week)							Evaluation Scheme					
			L	P	T	H	CR			CIE	ETE	TW	PR	OR	Total
							TH	PR/ Tut	Total						
25RAPC405	PCC	Robot Kinematics & Dynamics	3	-	-	3	3	-	3	40	60	-	-	-	100
25RAPC405P	PCC	Robot Kinematics & Dynamics Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25RAPC406	PCC	Sensors & Instrumentation	3	-	-	3	3	-	3	40	60	-	-	-	100
25RAPC406P	PCC	Sensors & Instrumentation Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25RAPC407	PCC	Advance Manufacturing Technology	3	-	-	3	3	-	3	40	60		-	-	100
25RAMD402	MDM	Digital Electronics & Microcontrollers	3	-	-	3	3	-	3	40	60	-	-	-	100
25RAMD402P	MDM	Digital Electronics & Microcontrollers Lab	-	2	-	2	-	1	1	-	-	-	-	25	25
25ALOE402	OE	Open Elective – II #	2	-	-	2	2	-	2	-	-	50	-	50	100
25RAMC402	HSSMC	Project Management System – I	-	2	-	2	-	1	1	-	-	25		-	25
25RAAE402	AEC	Problem Solving Techniques – II	-	2	-	2	-	1	1	-	-	25		-	25
25RAVS406	VSEC	Python for Robotics	-	2	-	2	-	1	1	-	-	-	25	-	25
25RACC406	CC	Liberal Learning - IV	-	2	-	2	-	1	1	-	-	25	-		25
25RAIN402	ELC - INT	Internship – II	4 Weeks				-	2	2	-	-	25	-	-	25
Total			**14**	**14**	**-**	**28**	**14**	**09**	**23**	**160**	**240**	**150**	**25**	**125**	**700**

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# - Select any one course from the given Open Elective Courses		
Course Code	**Course Type**	**Open Elective - II**
25ALOE402A	OEC	Cyber Security and Laws
25ALOE402B		Sustainability and Climate Change
25ALOE402C		Energy Audit and Electrical Safety
25ALOE402D		Digital Marketing
25ALOE402E		Entrepreneurship and Innovations

BoS Chairman

ZES's Zeal College of Engineering & Research PU/PN/Engg./285/2007 Narhe, Pune-41

Director
ZES's Zeal College of Engineering & Research Narhe, Pune - 411041.

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SYLLABUS

SEMESTER - III

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation)							**Semester:** III		
Course: Structural Mechanics for Robotic Applications							**Code:** 25RAPC302		
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
04	-	-	04	40	60	-	-	-	100

Prerequisites:

Basic Physics and Mathematics, Engineering Mechanics, Problem-Solving Skills.

Course Objectives:

1. To understand the fundamental concepts of stress, strain, and deformation in solid materials.
2. To analyze the stresses developed in bars, compound bars, beams and shafts.
3. To develop an understanding of the calculation of shear force and bending moment for beams with different supports.
4. To analyze and calculate the flexural and shearing behaviors of structural components to ensure the load-bearing capacity of robotic arms.
5. To evaluate structural integrity and stability of robotic arm under buckling, and strain energy capacities.

Course Outcomes: After completion of this course, students will be able to -

CO1	Describe stress-strain concepts and their relevance to robotic structural elements
CO2	Analyze axial, shear and torsional stresses in components of robotic systems
CO3	Analyze the structural members subjected to shear and bending loads.
CO4	Analyze the theories of bending and shear for robotic arm.
CO5	Apply the fundamental principles of pure torsion to analyze robotic drive shafts, joints ensuring optimal torsional rigidity and power transmission.
CO6	Evaluate the critical buckling loads of columns under various end conditions

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Mechanics of Solids** Concept of stress and strain: axial, shear, bearing stress, and strain, Hooke's Law, Poisson's Ratio, Elastic constants, Stress-strain diagrams for ductile and brittle materials, Importance of material behavior in robotic links and end-effectors.	08
2.	**Axial and Thermal Stress in Robotic Components** Determinate and Indeterminate structures, Axial force diagram, stresses, strains, strains & deformations in different structures, homogenous and composite bars under concentrated loads, stress and strain in a bar due to self-weight and temperature changes.	08

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3.	**Shear Force and Bending Moment:** Type of beams, Loads and reactions, Relationship between loads, shear force and bending moments, Shear force and bending moments of cantilever beams, Pin support and roller supported beams subjected to concentrated loads, uniformly distributed constant and varying loads.	09
4.	**Bending and Shear in Robotic Arms** **Bending stresses:** Theory of simple bending, assumptions, derivation of flexure formula, second moment of area of common cross sections with respect to centroidal and parallel axes. **Shear stresses:** Concept, derivation of shear stress distribution formula, shear stress distribution diagram for common symmetrical sections, maximum and average shear stress, shear connection between flange and web.	09
5.	**Torsion in Robotic Shafts and Joints** Stresses, strains and deformations in shafts of solid and hollow homogeneous circular cross section subjected to twisting moment. Derivation of torsion equation. Stresses due to combined torsion, bending and axial force on shafts. Torsional moment of resistance.	09
6.	**Columns** Failure of a column**,** Euler's column theory, Buckling and stability, Critical load, Column with pinned ends, Column with other support conditions, Effective length of columns. **Strain Energy** **S**train energy due to axial, shear, bending, torsion and impact loads.	09
	TOTAL	**52**

Text Books:

1. **Timoshenko and Gere**, "Mechanics of Materials", McGraw Hill
2. **R.K. Bansal**, "Strength of Materials", Laxmi Publications
3. **Ferdinand Beer & E. Russell Johnston**, "Mechanics of Materials", McGraw Hill

Reference Books:

1. **Gere & Goodno**, "Mechanics of Materials", Cengage Learning
2. **J.P. Den Hartog**, "Strength of Materials", Dover Publications
3. **S.S. Rattan**, "Strength of Materials", McGraw Hill

E-Resources:

1. **NPTEL - Strength of Materials – IITM -** https://onlinecourses.nptel.ac.in/noc25_me107/preview
2. **MIT Open Course ware- Structural Mechanics-** https://ocw.mit.edu/courses/2-080j-structural-mechanics-fall-2013/
3. **The Efficient Engineers – Mechanics of Materials** https://www.youtube.com/playlist?list=PLEYqyyrmhQ3wtF34smyJSAOqUJqnf1ch

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Program: B. Tech. (Robotics and Automation)						**Semester:** III			
Course: Structural Mechanics for Robotic Applications Lab						**Code:** 25RAPC302P			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites:

Basic Physics and Mathematics, Engineering Mechanics, Problem-Solving Skills.

Course Objectives:

1. Understand the mechanical behavior of engineering materials under tensile, compressive, torsional, shear, and bending loads.
2. Perform standard material testing experiments using UTM and other testing equipment to determine mechanical properties.
3. Analyze stress, strain, deformation, shear force, bending moment, and deflection in structural and mechanical components.
4. Apply FEM tools such as ANSYS to simulate and evaluate stress concentration, stress distribution, and deformation.

Course Outcomes: After completion of this course, students will be able to -

CO1	Perform tensile, compression, torsion, shear, and bending tests to determine the mechanical properties of engineering materials.
CO2	Analyze the stress, strain, deformation, and failure behavior of structural and robotic engineering components under different loading conditions.
CO3	Develop and analyze FEM models using ANSYS to evaluate stress concentration, stress distribution, and deflection in beams, columns, and other components.
CO4	Interpret and validate experimental and simulation results for the design and selection of materials and components used in robotics and automation systems.

Course Contents:

Exp. No	**Description**	**Duration (Hrs.)**
Any Eight form the following		
1.	Tension Test on Mild Steel Specimen using UTM	04
2.	Torsion Test on Mild Steel or Aluminum Shaft	04
3.	Compression Test on Robotic Gripper Material (e.g., Aluminum)	04
4.	Shear Test on Metallic Specimen	04
5.	Bending Test on Beam (Cantilever/Simple Support)	02
6.	Determination of Stress Concentration using FEM Simulation	02
7.	Stress and Deflection analysis of Simply Supported beam using ANSYS.	02
8.	To draw Shear stress and bending moment diagram for a beam using ANSYS.	02
9.	Stress and Deflection Analysis of Column using ANSYS	02
Total		**26**

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List of Experiments:
Text Books:
1. **Timoshenko and Gere**, "Mechanics of Materials", McGraw Hill 2. **R.K. Bansal**, "Strength of Materials", Laxmi Publications 3. **Ferdinand Beer & E. Russell Johnston**, "Mechanics of Materials", McGraw Hill
Reference Books:
4. **Gere & Goodno, "Mechanics of Materials", Cengage Learning** 5. **J.P. Den Hartog, "Strength of Materials", Dover Publications** 6. **S.S. Rattan, "Strength of Materials", McGraw Hill**
E-Resources:
4. **Virtual Lab – IIT B -https://sm-nitk.vlabs.ac.in/**

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Program: B. Tech. (Robotics and Automation)								**Semester:** III	
Course: Electrical Machines and Drives								**Code:** 25RAPC303	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Fundamentals of Electrical Engineering, Basic Electronics Engineering.

Course Objectives:

1. To study principle of operation of DC machines, its braking and speed control methods.
2. To know about three phase induction motor working, speed control methods and its applications.
3. To study the working principle of single-phase induction motors.
4. To understand the working principle of special purpose motors and their applications.
5. To get familiar with various electrical drives and their uses.
6. To understand the operation and performance of DC drives.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the operation of DC motor, its speed control methods and braking.
CO2	Explain types of three phase induction motor and its characteristic features and speed control methods.
CO3	Develop the capability to identify and select suitable Single-phase induction motor for given industrial application.
CO4	Develop the capability to identify and select suitable Special Purpose motor for given industrial application.
CO5	Understand the basics of electric drives and fundamentals of drive dynamics.
CO6	Understand the operation of DC motor drives and their applications.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**D.C. Motors and their Control:** Principles of working, Significance of back EMF, (Simple numerical on particular topics) Torque Equation, Types, Characteristics and Selection of DC Motors, Starting of DC Motors, Speed Control methods of DC Motor, Braking in DC motor and its types.	06
2.	**Three-Phase Induction Motor:** Types of induction motor, torque and power output, (Simple numerical on particular topics) starting methods, speed control, induction generator, starters (DOL starter and Star Delta starter), Methods of speed control- voltage and frequency control, variable frequency drive, applications.	07

3.	**Special Purpose Motors – Part 1:** Single phase induction motors, (types, construction, working principle of split phase and shaded pole type induction motors), descriptive treatment for AC series motor (difference between AC series and DC series motor, construction and working) and their applications.	07
4.	**Special Purpose Motors – Part 2:** Construction, working principle, characteristic and applications of stepper motors drives, A.C. and D.C servomotor drives, Universal motors, BLDC motors, PMDC motors, industrial applications, Linear induction motors and their applications.	06
5.	**Electric Drives, Dynamics and Control:** Definition, Advantages of electrical drives, Components of Electric drive system, Selection Factors, drive classifications, Motor-Load Dynamics, Speed Torque conventions and multi quadrant operation, Equivalent values of drive parameters. Load Torque Components. Nature and classification of Load Torques and selection motors.	07
6.	**Motor Drives and their Applications:** DC motors and their performance starting, transient analysis, Ward Leonard drives, Controlled rectifier fed drives, full controlled 3 phase rectifier control of dc separately excited motor, multi-quadrant operation, Chopper controlled drives Closed loop speed control of motor, applications of motor drives.	06
	TOTAL	**39**

Text Books:

1. Hughes Edward, "Electrical and Electronic Technology", Pearson Education.
2. Ashfaq Husain, "Electric Machines", 3rd Ed, Dhanpat Rai & Sons.
3. Bhattacharya S. K., "Electrical Machine", 3rd Ed, Tata McGraw Hill
4. Nagrath & Kothari, "Electrical Machines", Tata McGraw Hill.
5. P. C. Sen, "Principles of Electric Machines and Power Electronics ", John Wiley and Sons Publication, second edition 1997.
6. B. K. Bose, "Modern Power Electronics and AC Drives", Pearson Education, Asia, 2003.

Reference Books:

1. Lowe, "Electrical Machines", Nelson Publications.
2. Pillai S. K., "A First Course on Electrical Drives", New Age International (P) Ltd.
3. M. H. Rashid, "Power Electronics -Circuits, devices and Applications", 3rd Edition, PHI Pub. 2004.
4. G. K. Dubey, "Fundamentals of Electrical Drives", Second edition (sixth reprint), Narosa Publishing house, 2001.

R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press.

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E-Resources:
1. **NPTEL Course-Electrical Machines** - https://onlinecourses.nptel.ac.in/noc25_ee124/preview 2. **NPTEL Course-Electrical Drives**- https://www.youtube.com/watch?v=6DctdwlDKhc 3. **NPTEL Course-Fundamentals of Electrical Drives** https://nptel.ac.in/courses/108104140

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation)								**Semester:** III	
Course: Electrical Machines and Drives Lab								**Code:** 25RAPC303P	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites:

Fundamentals of Electrical Engineering, Basic Electronics Engineering.

Course Objectives:

1. Understand the operation and specifications of electrical motors.
2. Perform tests to evaluate motor performance.
3. Analyze speed, torque, and braking characteristics.
4. Understand motor drives and their applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify specifications and components of electrical motors.
CO2	Perform tests and evaluate motor performance.
CO3	Analyze speed, torque, and braking characteristics.
CO4	Select suitable motors and drives for robotics and automation applications.

Course Contents:

Exp. No.	**Description**	**Duration (Hrs.)**
Any Eight from the following		
1.	Demonstration of use of starters for DC motor and three phase induction motor along with understanding of specifications on name plates of these machines.	02
2.	Brake test on DC shunt motor.	04
3.	Study of power electronic converter-based DC motor drive.	04
4.	Study of electrical braking of DC shunt motor (Rheostatic/ Plugging/regenerative)	04
5.	Load test on three phase induction motor.	04
6.	Torque- speed characteristics of three phase induction motor.	04
7.	Study of BLDC Motor and its components.	02
8.	Study of Servo Motor and its components.	02
9.	Industrial Visit	-
	Total	**26**

Reference Books:

1. Lowe, "Electrical Machines", Nelson Publications
2. G. K. Dubey, "Fundamentals of Electrical Drives", Second edition (sixth reprint), Narosa Publishing house, 2001.
3. R. Krishnan, "Permanent Magnet Synchronous and Brushless DC Motor Drives", CRC Press

E-Resources:

1. **Virtual Lab Link: Fundamentals of Electrical Engineering**
   https://iitb.vlabs.co.in/discipline.html?discipline=Electrical_Engineering

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Program: B. Tech. (Robotics and Automation)								**Semester:** III	
Course: Smart Materials & MEMS								**Code:** 25RAPC304	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Physics, Chemistry, Basic Electronics, Electrical Circuits.

Course Objectives:

1. To understand the fundamentals of crystal structures.
2. To understand working principles and unique properties of each smart material type.
3. To understand the fundamental behaviors of Shape Memory Alloys.
4. To equip the knowledge of polymer and composite materials used in robotics
5. To understand the MEMS technology, including materials, fabrication techniques, and applications of MEMS sensors and actuators in robotics.
6. To introduce the integration of MEMS and smart materials, exploring their applications in advanced robotics.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain and differentiate between crystal structures and describe lattice parameters and Miller indices.
CO2	Explain the general working principles behind the actuation or sensing behavior of each type of smart material.
CO3	Describe phase transformation and pseudo-elastic behavior of SMAs and explain their actuation capabilities
CO4	Select appropriate polymer and composite materials for specific robotic components
CO5	Analyze MEMS sensors and actuators and their applications in robotic systems.
CO6	Analyze the role of integrated smart materials and MEMS

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Engineering Materials & Material Characteristics:** **Crystal Structures:** Study of Crystal structures BCC, FCC, HCP and lattice parameters & properties, Miller indices, Crystal imperfections, and Diffusion Mechanisms. **Material Properties:** Mechanical (Impact, hardness, etc.), Electrical, optical and Magnetic Properties **Fracture:** Types fractures (brittle, ductile) Creep & Fatigue failures. **Selection of materials** for robotic frames, gears, links, and end-effectors, Limitations and challenges with conventional materials in robotics.	07

2.	**Introduction to Smart Materials:** Types and classification of smart materials, Piezoelectric, Shape Memory Alloys (SMA), Electro-Rheological (ER) fluids, Magneto-Rheological (MR) fluids, Electroactive Polymers (EAP), General working principles, advantages over conventional materials. Applications in Robotics: sensors, actuators, adaptive components.	07
3.	**Behavior and Applications of Smart Materials:** **Shape Memory Alloys**: Phase transformation, pseudoelasticity", actuation, **Piezoelectric materials**: Direct/inverse effects, sensing, and actuation, **Magnetostrictive materials**: Working principle, robotic applications, **ER/MR Fluids**: Viscosity control, adaptive damping, robotic suspension, Application-focused case studies in soft robotics, micro grippers, precision actuators	07
4.	**Polymer and Composite Materials in Robotics:** Polymers: ABS, Nylon, PTFE, etc. used in flexible and lightweight robots**,** Selection criteria of polymer material for robots. **Composites:** Carbon-fiber reinforced plastics (CFRP), Glass-fiber composites**.** Use in humanoid shells, prosthetics, drone arms, and structural frames**,** Thermal, corrosion and wear considerations**,** Emerging biodegradable and sustainable materials in robotics.	07
5.	**Micro-Electro-Mechanical Systems (MEMS):** Introduction to MEMS: Scaling laws and microsystem relevance, **Materials for MEMS:** Silicon, polymers, metals, **MEMS fabrication**: Photolithography, etching, deposition, packaging, **MEMS sensors in robotics:** accelerometers, gyros, tactile sensors, MEMS actuators: Electrostatic, thermal, piezo-based.	06
6.	**Integration and Future of Smart Materials and MEMS:** **MEMS and Smart Material integration:** Artificial muscles, microfluidics, Smart composites for embedded sensing and actuation, Role in bio-inspired robotics, medical robotics, and wearables, Industry 4.0 and IoT-enabled smart materials. **Future trends:** Nanomaterials, flexible electronics, bio-MEMS.	05
TOTAL		**39**

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Text Books:

1. Vijay K. Varadan et al., "Smart Material Systems and MEMS", Wiley.
2. N.P. Mahalik, "*MEMS"*, Tata McGraw-Hill.
3. M. Addington and D. Schodek, "Smart Materials and Technologies", Elsevier
4. Agrawal B.K., "Introduction to Engineering Metallurgy, Forming and welding", Tata McGraw-hill publishing, 2006.
5. Kodgire V. D., "Materials science and metallurgy for Engineers", Everest Publishing House, Pune.
6. K. G. Bundinski, M. K. Bundinski, "Engineering Materials" Prentice Hall of India Pvt. Ltd., New- Delhi.
7. Smith W. F., "Principles of Materials Science and Engineering", McGraw- Hill Inc. Book Company.

Reference Books:

1. Rollason E. C., "Metallurgy for Engineering", ELBS Publishing.
2. Tai-Ran Hsu, "MEMS and Microsystems", McGraw-Hil
3. William D. Callister, "Materials Science and Engineering", Wiley
4. Clark D.S.and Vamey W. R. "Physical Metallurgy for Engineers", East-West Press Pvt. Ltd., New Delhi.
5. Donald R. Askeland & Pradeep Phule. , "The science and engineering of materials", Thomson Asia Pvt. Ltd.

E-Resources:

1. **Materials Science and Engineering**
   https://nptel.ac.in/courses/113106032
2. **OpenCourseWare – Smart Materials and Structures**
   https://ocw.mit.edu/courses/3-012sx-structure-of-materials-spring-2019/
3. **Introduction to Smart Material**
   https://nptel.ac.in/courses/112104173
4. **Smart Materials and Structures Journal**
   https://www.tandfonline.com/journals/tsma20

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation Engineering)								**Semester:** III	
Course: Engineering Mathematics – III								**Code:** 25RAMD301	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Differential and Integral calculus, Differential, Fourier series, Vector algebra.

Course Objectives:

1. To understand methods of solving differential equations.
2. To understand Laplace Transform techniques.
3. To understand Fourier Transform techniques.
4. To understand statistical and probability methods.
5. To understand vector integral theorems.
6. To understand partial differential equations and their applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand higher-order linear differential equations and their applications.
CO2	Evaluate Laplace transforms for analyzing control systems in robotics and automation.
CO3	Evaluate Fourier Transform techniques for signal analysis in robotics and automation systems.
CO4	Select data using statistical and probability concepts.
CO5	Apply the knowledge of vector integral calculus to solve the fluid flow problems.
CO6	Analyze partial differential equations such as wave equations and one- and two-dimensional heat flow equations.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Linear Differential Equations:** Linear Differential Equations (LDE) of nth order with constant coefficients, Method of variation of parameters, Cauchy's and Legendre's D.E., Simultaneous DE and Symmetric DE, Applications of differential equations in mass spring systems.	07
2.	**Laplace Transforms:** Definition and properties of Laplace transform, Inverse Laplace transform, Applications of Laplace transform to solve differential equation.	06
3.	**Fourier Transforms:** Fourier Transform (FT): Fourier integral theorem, Fourier transform, Fourier Sine & Cosine transform, Inverse Fourier Transforms.	06

4.	**Statistics & Probability:** Measures of central tendency, Measures of dispersion, Moments, Skewness and Kurtosis, Correlation and Regression analysis, Definition and Theorems on Probability, Probability distributions: Binomial, Poisson, Normal: Test of Hypothesis, Chi Square Test.	07
5.	**Vector Integral Calculus:** Line integral, work done, Green's Lemma, Gauss's Divergence theorem and Stokes's theorem.	06
6.	**Partial Differential Equations (PDE) and Applications:** Partial Differential Equations (PDE), Solution of PDE, modeling and solution of Vibrating String, One- and Two-dimensional Heat flow problems.	07
	TOTAL	**39**

Text Books:

1. B. V. Ramana, "Higher Engineering Mathematics", Tata McGraw-Hill.
2. B. S. Grewal, "Higher Engineering Mathematics", Khanna Publications, Delhi.
3. P. N. Wartikar and J. N. Wartikar, "Applied Mathematics, Volumes I and II", Pune Vidyarthi Griha Prakashan, Pune.

Reference Books:

1. Erwin Kreyszig, "Advanced Engineering Mathematics", Wiley India.
2. M. D. Greenberg, "Advanced Engineering Mathematics, 2e", Pearson Education.
3. Peter V. O'Neil, "Advanced Engineering Mathematics, 7e", Cengage Learning.
4. S. L. Ross, "Differential Equations, 3e", Wiley India.
5. Sheldon M. Ross, "Introduction to Probability and Statistics for Engineers and Scientists, 5e", Elsevier Academic Press.
6. S. J. Farlow, "Partial Differential Equations for Scientists and Engineers", Dover Publications, 1993.

E-Resources:

1. Ordinary Differential Equations and Applications
   https://nptel.ac.in/courses/111106100
2. Differential Equations
   https://ocw.mit.edu/courses/18-03-differential-equations-spring-2010
3. Virtual Labs – Differential Equations Applications
   https://al-dei.vlabs.ac.in/exp/ordinary-linear-differential/
4. Virtual Labs-Mass Spring System Simulation (PhET)
   https://phet.colorado.edu/en/simulation/masses-and-springs
5. NPTEL Course "Probability Theory and Applications",
   https://nptel.ac.in/courses/111/104/111104079/

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OPEN ELECTIVE - I

(Select any one course from the given Open Elective Courses)

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)								**Semester:** III	
Course: Open Elective – I (Digital Literacy and Applications)								**Code:** 25ALOE301A	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	-	50	100

Prerequisites:

Basic computer knowledge, use of internet and mobile devices.

Course Objectives:

1. To introduce students to fundamental digital skills and online applications.
2. To enhance understanding of modern information and communication technologies (ICT).
3. To develop practical skills in digital tools, online collaboration, and data management.
4. To promote safe, ethical, and effective use of technology in professional and personal life.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate proficiency in using essential digital tools for everyday tasks.
CO2	Apply safe and secure practices while using the internet and online services.
CO3	Utilize online collaboration platforms for communication and teamwork.
CO4	Develop simple digital content (documents, presentations, basic websites).
CO5	Leverage emerging digital applications for academic, professional, and social needs.
CO6	Create a simple web application and explain emerging technologies in everyday life.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Digital Literacy**: Evolution of Digital Technology – Role of ICT in modern life – Hardware and Software basics – Overview of digital devices (Computers, Smartphones, Tablets) Operating Systems and Applications.	04
2.	**Internet and Web Fundamentals:** Basics of Internet – Web Browsers – Search Engines – Online Communication Tools (Email, Chat, Video Conferencing) – Netiquette – Cloud Storage and File Sharing.	04
3.	**Digital Tools for Productivity:** Word Processing (MS Word/Google Docs), Spreadsheet Fundamentals (MS Excel/Google Sheets), Presentation Tools (PowerPoint/Canva), Templates and Online Collaboration (Google Workspace, MS Teams).	04
4.	**Cyber Safety and Digital Ethics:** Online Security Threats – Password Management – Safe Browsing – Data Privacy	04

	– Cyberbullying – Digital Footprint – Intellectual Property Rights in the digital era.	
5.	**Social media and Online Applications:** Role of social media in Communication – Online Professional Networking (LinkedIn) – Blogging and Content Sharing Platforms – Basics of Digital Marketing – E-Governance and Online Services (Banking, Payments, Education Portals).	05
6.	**Introduction to Web and Mobile Applications**: Creating a Simple Blog/Portfolio Website (Using WordPress/Wix) – Overview of Mobile Apps for Education and Productivity – Emerging Technologies (Cloud Computing, IoT, AI) in everyday life.	05
TOTAL		**26**

Text Books:

1. Pradeep K. Sinha, Priti Sinha, "Computer Fundamentals", BPB Publications.
2. Rajaraman, "Fundamentals of Computers", PHI Learning.

Reference Books:

1. Alan Evans, Kendall Martin, Mary Anne Poatsy, "Technology in Action", Pearson Education.
2. Daniel Scott, "Digital Literacy Unpacked", Facet Publishing.

E-Resources:

1. NPTEL: https://nptel.ac.in
2. Digital Literacy Course, Google: https://learndigital.withgoogle.com
3. Microsoft Learn: https://learn.microsoft.com
4. W3Schools Basics: https://www.w3schools.com

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)									**Semester:** III
Course: Open Elective – I (Environmental Studies)									**Code:** 25ALOE301B
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	-	50	100

Course Objectives:

1. To understand the structure and functions of ecosystems and the importance of biodiversity.
2. To study advanced energy systems and their role in sustainable development.
3. To learn concepts of natural resource management and disaster management through case studies.
4. To understand sources, impacts, and control measures of environmental pollution and waste management.
5. To create awareness about global environmental issues and environmental toxicology.
6. To gain knowledge of environmental assessment, management systems, and pollution control tools.

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

CO1	Understand the structure and functions of major ecosystems and the significance of biodiversity conservation
CO2	Evaluate various advanced energy systems in terms of their merits, demerits, and global applications
CO3	Apply concepts of natural resource management and disaster management using relevant case studies.
CO4	Analyze the sources, impacts, and control measures of environmental pollution and waste management practices.
CO5	Evaluate global environmental concerns and suggest sustainable solutions for issues like climate change and groundwater depletion.
CO6	Utilize environmental management tools and prepare environmental impact assessments following legislative guidelines.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Ecosystems** (Structure and Function): Forest, Desert, Wetlands, River, Oceanic and Lake. Biodiversity: Types, Value, Hot-spots, Threats and Conservation of biodiversity, Forest Wealth and Deforestation.	04
2.	**Advances in Energy Systems** (Merits, Demerits, Global Status and Applications): Hydrogen, Solar, OTEC, Tidal and Wind. Natural Resource Management (Concept and case-studies): Disaster Management, Sustainable mining, case studies, and Carbon Trading.	05

3.	**Environmental Pollution** (Sources, Impacts, Corrective and Preventive measures, Relevant Environmental Acts, Case-studies): Surface and Groundwater Pollution, Noise pollution, Soil Pollution and Air Pollution. **Waste Management & Public Health Aspects**: Bio-medical Wastes, Solid waste, Hazardous wastes, E-wastes, Industrial and Municipal Sludge.	05
4.	**Global Environmental Concerns** (Concept, policies and case-studies): Groundwater depletion/recharging, Climate Change, Acid Rain, Ozone Depletion, Radon and Fluoride problem in drinking water, Resettlement and rehabilitation of people, Environmental Toxicology.	03
5.	**Latest Developments in Environmental Pollution Mitigation Tools** (Concept and applications): G.I.S. & Remote Sensing, Environmental Management Systems, ISO14001, Environmental Stewardship- NGOs.	04
6.	**Environmental Assessment, Management and Legislation** Aims and objectives of Environmental Impact Assessment (EIA), Environmental Impact Statement (EIS). EIA Guidelines, Impact Assessment Methodologies, Procedure for reviewing EIA of developmental project, Life-cycle analysis, cost benefit analysis, Guidelines for Environmental Audit.	05
	TOTAL	**26**

Text Books:

1. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T., "Environmental Encyclopedia", Jaico Publications House, 1st edition, 2000.
2. Agarwal, K.C, "Environmental Biology", Nidhi Publishers, 2nd edition, 2008.

Reference Books:

1. Erach Bharucha, "The Biodiversity of India", Mapin Publishing Pvt. Ltd., 1st Edition, 2002.
2. Brendan Gleeson and Nicholas Low (Eds.), "Global Ethics and Environment", Routledge, London, 1999.
3. Peter H. Gleick, "Water in Crisis", Pacific Institute for Studies in Development, Environment & Security, Stockholm Environment Institute, Oxford University Press, 1993.
4. Martha J. Groom, Gary K. Meffe, and Carl Ronald Carroll, "Principles of Conservation Biology", Sinauer Associates, Sunderland, 2006.
5. R. Edward Grumbine and M. K. Pandit, "Threats from India's Himalaya Dams", Science, Vol. 339, pp. 36–37, 2013.
6. Patrick McCully, "Rivers No More: The Environmental Effects of Dams", pp. 29–64, Zed Books, 1996.

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E-Resources:
1. NPTEL video lecture on Environmental Impact Assessment https://www.youtube.com/watch?v=_iLdyhgFv1U 2. Sustainability Concepts - Innovations and Challenges https://www.youtube.com/watch?v=A9PGRnkLubE&list=PLbRMhDVUMngd2-jPdQSk3QNBTf2n7FxXU&index=2 3. Natural Resources Management

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)								**Semester:** III	
Course: Open Elective – I (Green Energy and Sustainability)								**Code:** 25ALOE301C	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	-	50	100

Prerequisites:

Renewable energy, power generation technology

Course Objectives:

1. To study cleaner production and life cycle assessment.
2. To understand green fuels.
3. To learn green technology and green engineering.
4. To learn waste management.
5. To study sustainable technologies.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand green technology principles, green chemistry, and process intensification for sustainable industries.
CO2	Evaluate the benefits, challenges, and environmental impact of green fuels compared to conventional fossil fuels.
CO3	Apply cleaner production principles and life cycle assessment for sustainability.
CO4	Evaluate waste types, audits, and management strategies with focus on health and environmental impact.
CO5	Explain sustainable technologies considering ecological, economic, and social dimensions.
CO6	Analyze practical challenges, case studies, and laws in implementing green technologies.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Principles of Green Technology and Green Engineering:** Processes and products for green safe and economically acceptable to the society, green chemistry and Process intensification. **Green Industrial Processes:** Pollution statistics from various industries. A greener approach towards all these industries.	04
2.	**Green Fuels:** Definition of Green Fuels, their benefits and challenges, comparison of green fuels with conventional fossil fuels with reference to environmental, economic and social impacts, public policies and market driven initiatives, Biomass energy: Concept of biomass energy utilization, types of biomass.	04

3.	**Cleaner Production:** Definition, Importance, Principles of Cleaner Production and its Benefits, Role of industry, Clean development mechanism, Reuse, Recovery, Recycle, Raw material substitution- Wealth from waste. Role of CP in Achieving Sustainability, Benefits, Role of Industry, Government and Institutions, Environmental Management, Pollution Prevention and Cleaner Production Awareness Plan, Environmental Statement, Carbon credit, Carbon trading. Introduction to Life Cycle Assessment (LCA) and Elements of LCA.	04
4.	**Waste Management:** Waste stream assessment (WSA), Waste generation and composition, Waste characteristics (physical and chemical), Waste audit, Health and Environmental effects (public health and environmental), Comparative assessment of waste generation and Composition of developing and developed nations, a case study results from an Indian city, Handouts on solid waste compositions. E-waste Generation.	05
5.	**Sustainable Technology:** Understand the Sustainable Technology, three principle dimensions: the ecological, the economic and the social dimension, including intergenerational justice; use a systems perspective, to describe sustainability challenges and possibilities for major technical systems and for their transformation to meet Sustainability requirements.	05
6	**Challenges and Practical Implementation:** Responsibilities and potentials of companies for action. Green Productivity and emerging technologies. Implementation of the practical applications of Green emerging technologies and sustainable development. Case studies in Green Technology. Green laws compliance.	04
TOTAL		**26**

Text Books:

1. Matlack A.S., "Introduction to Green Chemistry", Marcel Dekker Publication.
2. Modak P., Visvanathan C. and Parasnis M., "Cleaner Production Audit Environmental System Reviews", Asian Institute of Technology Publication.
3. Anastas P.T. and Warner J.C., "Green Chemistry: Theory and Practice", Oxford University Press.
4. Bishop P. L., "Pollution Prevention: Fundamentals and Practice", McGraw-Hill Publication, Boston.
5. Clark J.H. and Macquarie D.J., "Handbook of Green Chemistry and Technology", Wiley Blackwell Publication.

Reference Books:

1. Sawyer C.N, McCarty P.L and Parkin G.F., "Chemistry for Environmental Engineering and Science", 5th ed. McGraw-Hill Professional Publication.
2. Paul L Bishop, "Pollution Prevention: Fundamentals and practice", McGraw-Hill International Publication.
3. Das A. K, "Environmental Chemistry with Green Chemistry", Books and Allied (P) Ltd. Publication.
4. V.K. Ahluwalia, "Green Chemistry Environmentally Benign Reactions", springer publication.
5. V.K. Ahluwalia, Ane. "Green Chemistry: Environmentally Benign Reactions", springer publication.
6. Mike Lancaster, "Green Chemistry: An Introductory Text", Royal Society of Chemistry publication.

E-Resources:

1. NPTEL Course on "Energy Resources, Economics and Sustainability", By Prof. Pratham Arora, IIT Roorkee, https://onlinecourses.nptel.ac.in/noc25_hs86/preview
2. NPTEL Course on "Sustainable Energy Technology", By Prof. Sayak Banerjee, IIT Hyderabad. https://onlinecourses.nptel.ac.in/noc23_me138/preview

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)				**Semester:** III					
Course: Open Elective – I (Basics of Consumer Electronics)				**Code:** 25ALOE301D					
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	-	50	100

Prerequisites:

Basic understanding of current, voltage, and electronic components and electronics components

Course Objectives:

1. Understand principles and components of audio, video, and communication systems.
2. Develop practical skills in installation, operation, and maintenance of electronics.
3. Prepare students for technical roles in electronics service and support industry.

Course Outcomes: After completion of this course, students will be able to - -

CO1	Understand the working principles and components of basic audio systems and home theatre setups.
CO2	Explain the functioning of modern video display technologies and remote-control operations.
CO3	Identify and describe the types, specifications, and working of projectors and CCTV systems.
CO4	Describe satellite communication principles and DTH system setup and components.
CO5	Explain the construction, working, and common issues in basic household appliances like washing machines, mixers, and induction cooktops.
CO6	Understand the operation and features of kitchen and office equipment such as microwave ovens, printers, and scanners.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Audio Systems:** Introduction to audio systems, Audio amplifier, Microphone, Loudspeaker, Public address system, DJ system: concept and components, Audio as Data and Signal, Digital Audio Processes: Time Compression & Expansion, Block diagram and working of home theatre system	04
2.	**Video Systems and Display Technologies:** Elements of TV communication system, Scanning process and its necessity, Comparison: CRT, LCD, and LED TVs, LCD and LED TV: principles and section-wise working, 3D TV: Basic working principle, IPS panels and features, Interfaces: HDMI, USB, RGB, etc., TV remote control: types, IR code transmission/reception, functions, faults	05
3.	**Projectors and Surveillance Systems:** LCD vs. LED Projectors: differences and specs, Working principle and faults in	04

	LED projectors, CCTV Cameras: types and specifications, CCTV setup and components, Digital Video Recorders: types and working	
4.	**Satellite Communication and DTH Technology:** Basics of satellite communication, Merits, demerits, and applications, Satellite types, orbits, frequency bands, Components of DTH: PDA, LNBC, satellite receiver, dish alignment, Cable types, impedance, MDU design, Set Top Box: block diagram, features, I/O ports, Cable modem termination system, software, CPE	05
5.	**Domestic Appliances – Part I**: Washing Machines: types, parts, block diagrams, timers, motors, Vacuum Cleaner: block diagram, working, features, motors, circuits, Mixer/Grinder: parts, speed control, auto overload protection, Electric Iron & Steam Iron: principle, thermostat, parts, Water Purifiers: RO/UV principles, components, faults, Immersion Heater: working, insulation, Induction Cooktop: principle, tubes, heat sinking, fault identification	04
6.	**Domestic Appliances – Part II and Office Equipment:** Microwave Oven: types, block & wiring diagram, microwave generation, Food Processors: parts and working, Printers: dot matrix, inkjet, laser; advantages, disadvantages, connectivity, Digital Electronic Lock, Xerox Machine, Scanner, Fax Machine	04
	TOTAL	**26**

Text Books:

1. S. P. Bali, "Consumer Electronics", 1st Edition, Paperback, English.
2. B. R. Gupta, "Consumer Electronics", Paperback, English.
3. Dr. J. S. Chitode, "Consumer Electronics – A Conceptual Approach".
4. Douglas Kinney, "A Beginner's Guide to Consumer Electronics Repair: Handbook and Tutorial".
5. Anand, "Consumer Electronics".
6. H. Davidson, "Troubleshooting Consumer Electronics Audio Circuits".

Reference Books:

1. Dennis Roddy, "Satellite Communications", McGraw Hill.
2. R. G. Gupta, "Audio Video Systems – Principles, Maintenance and Troubleshooting", Tata McGraw-Hill.
3. David A. Bell, "Electronic Devices and Circuits", Oxford University Press.
4. S. P. Sharma, "Appliance Servicing and Repair Guide", Katson Books

E-Resources:

1. Audio System Engineering (IIT Kharagpur),
   Course page: https://nptel.ac.in/courses/117/105/117105133
2. Satellite Communication & DTH
   NOC: Satellite Communication Systems (IIT Kharagpur)
   Course page: https://archive.nptel.ac.in/courses/117/105/117105131/

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)							**Semester:** III		
Course: Open Elective – I (Renewable Energy Systems)							**Code: 25**ALOE301E		
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	-	-	50	-	50	100

Prerequisites:

Fundamentals of Mechanical Engineering, Physics, Thermodynamics.

Course Objectives:

1. Discuss the global and national energy scenarios and environmental impacts and sustainability concerns associated with fossil fuel use.
2. Identify and explain the working principles of solar radiation measuring instruments including pyrheliometers, pyranometers, and sunshine recorders.
3. Classify various types of wind-mills and describe their structural components.
4. Introduce biomass as an energy source and describe biomass conversion technologies.
5. Describe the construction, working, and applications of various renewable energy sources.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify and describe the main types of renewable energy sources and their respective limitations.
CO2	Compare various types of solar collectors based on design and performance.
CO3	Identify and explain factors affecting wind characteristics and wind energy generation.
CO4	Interpret the advantages and limitations of biomass energy in comparison with other renewable sources.
CO5	Apply energy conversion principles to assess the feasibility of alternative energy systems.
CO6	Compare the suitability of renewable energy technologies (like fuel cells) for specific applications.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Renewable Energy:** Environmental consequence of fossil fuel, Limits Of Fossil Fuel, Energy Scenario, Classification of Energy Sources, types of renewable energy sources, limitations.	04
2.	**Solar Energy:** Environmental impacts of solar energy, Solar radiation measurements, Solar constant, Solar Radiation Measuring Instruments (Radiometers): Pyrheliometers, Pyranometers, Sunshine recorder, classification of solar collectors	05
3.	**Wind Energy:** Factors affecting the wind, Classification of Wind-mills, Main Components of a wind-mill, wind speed prediction, Advantages of Fixed and variable speed	04

	systems,	
4.	**Biomass Energy:** Introduction, Biomass Conversion, Types of biogas plants: Floating dome type, Fixed dome type, Biodiesel, Significance of biodiesel	04
5.	**Other Forms of Renewable Energy Sources**: Introduction, hydro energy, geothermal energy, wave & tidal energy, Energy Conversion Principles, Environmental considerations	04
6.	**Applications of Renewable Energy Sources**: Photovoltaic (PV) cell, Solar water heater, Crop and Grain Drying, Space and Water Heating, Solar Energy Applications for Agriculture, Fuel Cell	05
	TOTAL	**26**

Text Books:

1. S. P. Sukhatme and J. K. Nayak, "Solar Energy: Principles of Thermal Collection and Storage", 3rd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2008.
2. J. Twidell and Tony Weir, "Renewable Energy Resources", 2nd Edition, Taylor & Francis, 2006.
3. B. H. Khan, "Non-Conventional Energy Resources", 2nd Edition, Tata McGraw-Hill Education Pvt. Ltd., 2009.
4. Prabir Basu, "Biomass Gasification, Pyrolysis and Torrefaction", Academic Press, Elsevier, 2013.

Reference Books:

1. O. P. Gupta, "Energy Technology", Khanna Book Publishing, New Delhi.
2. V. V. N. Kishore, "Renewable Energy Engineering and Technology: Principles and Practice", Routledge, 1st Edition, 2019.
3. N. Jenkins and J. Ekanayake, "Renewable Energy Engineering", Cambridge University Press, 1st Edition, 2017.
4. G. Boyle, "Renewable Energy", OUP Oxford, 2nd Edition, 2009.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc22_ph44/preview
2. https://nptel.ac.in/courses/103103206
3. https://onlinecourses.swayam2.ac.in/nou22_ge71/preview
4. https://www.coursera.org/specializations/renewable-energy
5. https://www.coursera.org/learn/exploring-renewable-energy
6. https://www.youtube.com/watch?v=VfowJHJz6-s

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** III	
Course: Problem Solving Techniques – I								**Code:** 25RAVS304	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Strategic thinking, natural, formal and informal logic, Conceptual clarity, logical reasoning, analytical mind.

Course Objectives:

1. To acquire basic knowledge of problem classification, identification, formulation and root cause analysis.
2. To understand the structured way of solving problems with the various right tools and techniques.
3. To understand process of creative problem solving and decision making.

Course Outcomes: After completion of this course, students will be able to -

CO1	Classify problems, able to define the problem statement precisely by analyzing its root cause.
CO2	Demonstrate solution of various problems using Fishbone and Five why techniques.
CO3	Apply tools to create new ideas using SCAMPER and carry out decision making scientifically.

Course Contents:

Unit	**Description**	
1.	**Fundamentals of Problem Solving:** Problem definitions, Classifications of problems-Simple and complex, structured, semi structured and unstructured problems with real life technical and non-technical examples, problem solving techniques- Root cause Analysis	
2.	**Tools and techniques of Problem Solving:** Fishbone Diagram (Ishikawa or Cause-and-Effect Diagram), 5 Whys technique, Demonstration of technique through case studies, parametric study of various problem finding in various sectors and its scientific approach (campus, manufacturing firm, environment, highways, students' fraternity, water and air pollution, national security etc.)	
3.	**Creative Problem Solving and Decision making:** Creativity, types of innovation, blocks of creativity, three components of creativity, Tools for defining existing problems and creation of new ideas, data collection and fact findings, Decision making, its tools, risk analysis, Delphi technique, SCAMPER technique	
	TOTAL	**26**

Text Books:

1. M.T. Somashekara, "Problem Solving and Programming Concepts", PHI Learning.
2. Dheeraj Sharma, "Problem Solving and Decision Making", McGraw-Hill Education.

Reference Books:
1. Willian Henderson, "Master Critical Thinking, Creative, Logic & Problem solving skills", Peak Publish LLC. 2. Sharma Narender, "Handbook 7 QC tools", Shakehand with Life.
E-Resources:
1. Coursera: "Creative Problem Solving" - https://www.coursera.org/learn/creative-problem-solving. 2. MindTools – "Problem Solving Techniques", https://www.mindtools.com/cx4ems0/problem-solving.

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Programming in C/C++						**Code:** 25RAVS305			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	50	50

Prerequisites:

Basic Fundamentals of Mathematics, Basic electronics and logic gates

Course Objectives:

1. To introduce the fundamentals of C/C++ programming
2. To develop algorithmic and logical thinking
3. To apply C/C++ for solving robotics-related problems
4. To build a foundation for microcontroller programming and embedded systems

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the history, structure, and development environment setup for C/C++ programming with Logic Building
CO2	Declare variables and apply appropriate data types in C/C++; perform input/output operations using
CO3	Write structured programs using operators, conditional statements, and loops; define and invoke user-defined functions for modularity.
CO4	Organize data using arrays, manipulate strings, define structures, and use pointers for memory referencing in robotic applications.
CO5	Implement file operations to read, write, and store sensor-related data in external files for robotic data logging.
CO6	Simulate basic robotic behaviors such as line follows and obstacle detection using decision-making logic and sensor data processing.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to C/C++ with logic building in Robotics**: History, IDE setup (TurboC++, Code::Blocks), structure of C/C++ program	05
2.	**Variables, Data Types, and I/O in Sensor Control**: Integer, float, char, string, input/output using scanf & printf	05
3.	**Operators and Control Flow in Robotic Decisions:** Arithmetic, logical, relational operators; if, switch, nested conditions **Loops and Functions**: for, while, do-while, recursion, function declaration and call	05
4.	**Arrays, Strings, Structures & Pointers for Robotic Data Handling**: Single & multidimensional arrays, character arrays, string functions **Structures and Pointers**: User-defined types, pointer basics, pointer with arrays & functions	05

5.	**File Handling for Robotic Data Logging**: Opening, reading, writing, closing files – used in logging sensor data	02
6.	**Practical Applications in Robotics**: Simulate line following logic, basic obstacle detection, command processing	04
TOTAL		**26**

List of Experiments:

1. Display "Hello, Robotics!" with Student Name Input
2. Arithmetic Operations on Sensor Data
3. Sensor Threshold Logic Using if-else
4. PWM Pulse Simulation using for Loop
5. Average Sensor Reading Using Function & Array
6. Switch-Case to Simulate Robot Modes (Idle, Active, Error)
7. Command Parsing: String Manipulation for "START", "STOP"
8. Structure to Hold Robot Sensor Data with Status
9. Pointer with Array: Sensor Data Access by Reference
10. File Handling: Log Sensor Readings into a Text File
11. Simulate LED Blinking using Loops and Delay Logic
12. Case Study: Simulate Line-Following Robot Logic

Reference Books:

1. Brian W. Kernighan and Dennis M. Ritchie, "The C Programming Language", Prentice Hall.
2. Robert Lafore, "Object-Oriented Programming in C++", SAMS.
3. S. R. Schach, "Introduction to Object-Oriented Programming with C++", McGraw-Hill.
4. E. Balagurusamy, "Programming in ANSI C", McGraw-Hill.
5. Yashavant Kanetkar, "Let Us C", BPB Publications.
6. Bjarne Stroustrup, "Programming — Principles and Practice Using C++", Addison-Wesley.

E-Resources:

1. NPTEL – Programming in C
   https://nptel.ac.in/courses/106104128
2. NPTEL – Problem Solving Through Programming in C
   https://nptel.ac.in/courses/106105171
3. NPTEL – Problem Solving Through Programming in C
   https://nptel.ac.in/courses/106105171
4. OnlineGDB C Compiler
   https://www.onlinegdb.com
5. Programming for Robotics (ETH Zurich)
   https://rsl.ethz.ch/education-students/lectures.html

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Program: B. Tech. (Robotics & Automation Engineering)							**Semester:** III		
Course: Project Based Learning							**Code:** 25RACE301		
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**		**Total**
-	02	-	01	-	-	25	-		25

Prerequisites: Fundamental Knowledge of Engineering, Communication skill, Team work & Collaboration

Preamble:

For better learning experience, along with traditional classroom teaching and laboratory learning; project-based learning has been introduced with an objective to motivate students to learn by working in group cooperatively to solve a problem.

Project-based learning (PBL) is a student-centric pedagogy that involves a dynamic classroom approach in which it is believed that students acquire a deeper knowledge through active exploration of real-world challenges and problems. Students learn about a subject by working for an extended period of time to investigate and respond to a complex question, challenge, or problem. It is a style of active learning and inquiry-based learning.

Problem based learning will also redefine the role of teacher as mentor in learning process. Along with communicating knowledge to students, often in a lecture setting, the teacher will also to act as an initiator and facilitator in the collaborative process of knowledge transfer and development.

Course Outcomes: After completion of this course, students will be able to -

CO 1	Project based learning will increase their capacity and learning through shared cognition.
CO 2	Students able to draw on lessons from several disciplines and apply them in practical way.
CO 3	Learning by doing approach in PBL will promote long-term retention of material and replicable skill, as well as improve teachers' and students' attitudes towards learning.

Group Structure:

Working in supervisor/mentor – monitored groups. The students plan, manage and complete a task/project/activity which addresses the stated problem.

- There should be team/group of 5 -6 students
- A supervisor/mentor teacher assigned to individual groups

Selection of Project/ Problem:

The problem-based project-oriented model for learning is recommended. The model begins with the identifying of a problem, often growing out of a question or "wondering". This formulated problem then stands as the starting point for learning. Students design and analyse the problem within an articulated interdisciplinary or subject frame.

A problem can be theoretical, practical, social, technical, symbolic, cultural and/or scientific and grows out of students' wondering within different disciplines and professional environments. A chosen problem has to be exemplary. The problem may involve an interdisciplinary approach in both the analysis and solving phases. By exemplarity, a problem needs to refer back to a particular practical, scientific, social and/or technical domain.

The problem should stand as one specific example or manifestation of more general learning outcomes

Related to knowledge and/or modes of inquiry. There are no commonly shared criteria for what Constitutes an acceptable project. Projects vary greatly in the depth of the questions explored, the clarity of the learning goals, the content and structure of the activity.

- A few hands-on activities that may or may not be multidisciplinary
- Use of technology in meaningful ways to help them investigate, collaborate, analyze, synthesize and present their learning.
- Activities may include- Solving real life problem, investigation /study and Writing reports of in-depth study, field work.

Assessment:

The institution/head/mentor is committed to assessing and evaluating both student performance and program effectiveness. Progress of PBL is monitored regularly on weekly basis. Weekly review of the work is necessary.

During process of monitoring and continuous assessment AND evaluation the individual and team performance is to be measured. PBL is monitored and continuous assessment is done by supervisor/mentor and authorities. Students must maintain an institutional culture of authentic collaboration, self-motivation, peer-learning and personal responsibility. The institution/department should support students in this regard through guidance/orientation programs and the provision of appropriate resources and services.

Supervisor/mentor and Students must actively participate in assessment and evaluation processes. Group may demonstrate their knowledge and skills by developing a public product and/or report and/or presentation.

- Individual assessment for each student (Understanding individual capacity, role and involvement in the project)
- Group assessment (roles defined, distribution of work, intra-team communication and togetherness)
- Documentation and presentation

Evaluation and Continuous Assessment:

It is recommended that the all activities are to be record and regularly, regular assessment of work to be done and proper documents are to be maintained at college end by both students as well as mentor (you may call it PBL work book).

Continuous Assessment Sheet (CAS) is to be maintained by all mentors/department and institutes.

Recommended parameters for assessment, evaluation and weightage:

- Idea Inception (5%)
- Outcomes of PBL/Problem Solving Skills/ Solution provided/ Final product (50%) (Individual assessment and team assessment)
- Documentation (Gathering requirements, design & modeling, implementation/execution, use of technology and final report, other documents) (25%)
- Demonstration (Presentation, User Interface, Usability etc.) (10%)
- Contest Participation/ publication (5%)

- Awareness /Consideration of -Environment/ Social /Ethics/ Safety measures/Legal aspects (5%)

PBL workbook will serve the purpose and facilitate the job of students, mentor and project coordinator. This workbook will reflect accountability, punctuality, technical writing ability and work flow of the work undertaken.

References:

- Project-Based Learning, Edutopia, March 14, 2016.
- What is PBL? Buck Institute for Education.
- www.schoology.com

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Liberal Learning - III

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)							**Semester:** III		
Course: Liberal Learning – III (Guitar)							**Code:** 25RACC305A		
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Guitar musical instrument.

Course Objectives:

1. To develop advanced guitar techniques, including scales, arpeggios, fingerstyle, and lead guitar skills.
2. To strengthen students' understanding of music theory, chord construction, harmony, improvisation, and melodic phrasing.
3. To enhance ensemble performance, stage confidence, musical communication, and readiness for intermediate-level performances.

Course Outcomes: After completion of this course, students will be able to -

CO1	Perform advanced scales, arpeggios, chord progressions, and fingerstyle techniques with accuracy.
CO2	Apply music theory concepts in lead guitar playing, improvisation, and melodic expression.
CO3	Demonstrate confident solo and ensemble performances with effective musical expression and stage readiness.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of Semester II concepts, Warm-up & Finger Independence	02
2.	Major & Minor Scale Revision (Two Octaves)	
3.	Pentatonic Scales & Blues Scale	
4.	Arpeggios and Picking Exercises	
5.	Chord Construction & Extended Chords (7th, Maj7, m7)	
6.	Chord Progressions in Different Keys	02
7.	Fingerstyle Techniques – Patterns & Independence	02
8.	Lead Guitar Techniques – Hammer-ons, Pull-offs, Slides	
9.	Improvisation using Pentatonic Scale	
10.	Genre-based Playing (Blues, Rock, Pop)	
11.	Ensemble Playing & Rhythm Coordination	
12.	Solo Performance Practice & Individual Corrections	02
13.	Mock Performance & Stage Preparation	02
TOTAL		**26**

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Text Books:

1. Hal Leonard Corporation, "Hal Leonard Guitar Method – Complete Edition", Hal Leonard Publications.
2. Mel Bay, "Modern Guitar Method – Grades 1, 2 & 3", Mel Bay Publications.
3. William Leavitt, "A Modern Method for Guitar (Books 1–3)", Berklee Press.
4. Richard Chapman, "The Complete Guitar Manual", DK Publishing.
5. Ralph Denyer, "The Guitar Handbook", Knopf Publishing..

Reference Books:

1. Troy Stetina, "Fretboard Mastery", Hal Leonard Publications.
2. Tom Kolb, "Music Theory for Guitarists", Hal Leonard Publications.
3. Don Latarski, "Practical Theory for Guitar", Alfred Music.
4. Bruce Buckingham, "Scales and Modes for Guitar", Hal Leonard Publications.
5. Mark Phillips and Jon Chappell, "Guitar For Dummies", Wiley Publishing.

E-Resources:

1. **Berklee Online** – Guitar lessons, music theory, ear training, and performance resources. https://online.berklee.edu
2. **Justin Guitar** – Structured guitar lessons from beginner to advanced. https://www.justinguitar.com
3. **Fender Play** – Interactive lessons on chords, scales, techniques, and songs. https://www.fender.com/play
4. **TrueFire** – Professional online guitar courses covering multiple genres and techniques. https://truefire.com
5. **Ultimate Guitar** – Tabs, chord charts, scales, and community resources. https://www.ultimate-guitar.com
6. **MuseScore** – Free music notation software and sheet music library. https://musescore.org
7. **MusicTheory.net** – Interactive music theory lessons and exercises. https://www.musictheory.net
8. **Yamaha Music India** – Educational resources on guitar fundamentals and musicianship. https://in.yamaha.com

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Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** III	
Course: Liberal Learning – III (Singing)								**Code:** 25RACC305B	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music in singing.

Course Objectives:

1. To develop students' understanding of prescribed ragas and talas through theoretical and practical study.
2. To enhance vocal skills through Alankar practice in Shuddha and Vikrit (Komal) Swaras and different musical forms.
3. To strengthen rhythmic knowledge, musical expression, voice culture, and stage performance skills.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate understanding of prescribed ragas, talas, and Alankars through accurate vocal performance.
CO2	Apply rhythmic patterns such as Bhajani Theka and Jhaptal in prescribed vocal compositions.
CO3	Perform festival songs, ghazals, and vocal compositions with proper pitch, voice control, musical expression, and stage confidence.

Course Contents:

Sr. No.	**Description**	
1.	Detailed Study of Prescribed Ragas: Raga Bageshree ,Raga Des, Raga Khamaj	6
2.	Study of Prescribed Talas: Bhajani Theka, Jhaptal	4
3.	Basic theory concepts	
4.	Identification of Raga Characteristics and Tala Structure	
5.	Festival Songs	
6.	Gazals	2
7.	Soulful / Light Vocal Songs	2
8.	Interpretation and Presentation of Different Song Styles	
9.	Practice of Ten Alankars in Shuddha/ Komal swaras	
10.	Alankars based on the Prescribed Ragas	
	TOTAL	**26**

Text Books:

1. V. N. Bhatkhande, "Kramik Pustak Malika (Vol. III & IV)", Publications.
2. V. D. Paluskar, "Sangeet Bal Prakash", Publications.

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Reference Books:
1. V. N. Bhatkhande, "Hindustani Sangeet Paddhati (Vol. I–IV)", Publications. 2. Ashok Da. Ranade, "Hindustani Music: Tradition in Transition", Publications. 3. S. N. Ratanjankar, "Abhinav Geet Manjari", Publications.
E-Resources:
1. Sangeet Natak Akademi - All India Radio (Akashvani) 2. SwarGanga Music Foundation 3. YouTube – Sangeet Natak Akademi Channel 4. Digital Tanpura and Tabla Applications (e.g., iTanpura, Riyaz, NaadSadhana)

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Program: B. Tech. (Robotics & Automation Engineering)				**Semester:** III					
Course: Liberal Learning – III (Cinematography)				**Code:** 25RACC305C					
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

A basic understanding of film theory, Camera operation, Lighting techniques and visual storytelling is essential for cinematography.

Course Objectives:

1. To identify and operate camera equipment while understanding camera functions and exposure settings.
2. To develop skills in composition, framing, perspective, and lighting techniques.
3. To create visual stories through different photography genres and creative image-making.
4. To apply basic photo editing and post-processing techniques using editing software.

Course Outcomes: After completion of this course, students will be able to -

CO1	Operate cameras and apply appropriate settings, exposure, and lighting techniques to capture quality photographs.
CO2	Compose visually appealing photographs using principles of composition, design, and creative framing.
CO3	Capture photographs across different genres such as portrait, landscape, product, event, and wildlife photography.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Introduction to Videography	02
2.	Basics of Video Camera operations	02
3.	Techniques for steady shooting (Tripod, Gimble)	02
4.	Basics shot types (Wide, Medium, Close-up)	02
5.	Basics shot types (Wide, Medium, Close-up)	02
6.	Camera Movement (Pan, Tilt, Roll)	02
7.	Practical	02
8.	Composition Technique - Focus and Depth of field	02
9.	Natural vs artificial lighting	02
10.	Practical	02
11.	Filming Techniques	02
12.	Audio Recording	02
13.	Practical Session	02
TOTAL		**26**

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Text Books:
1. Peterson, B., "Understanding Exposure – Theory + Fundamentals", Amphoto Books. 2. Kelby, S., "The Digital Photography Book – Practical + Shooting", Rocky Nook.
Reference Books:
1. Langford, M., "Langford's Basic Photography – Technical Concepts", Focal Press. 2. Freeman, M., "The Photographer's Eye – Composition, Visual Balance, Framing, Perspective", Ilex Press.
E-Resources:
1. https://www.youtube.com/watch?v=xKRh4PI-BKg 2. https://www.youtube.com/@StudioBinder/videos

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)							**Semester:** III		
Course: Liberal Learning – III (Dance)							**Code:** 25RACC305D		
Teaching Scheme (Hrs./week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Good stamina, flexibility and familiarity with simple rhythmic patterns and beats.

Course Objectives:

1. To strengthen students' technical proficiency through advanced Adavus, Jathis, and rhythmic patterns.
2. To develop expressive skills (Abhinaya) by interpreting simple classical compositions.
3. To enhance coordination, balance, posture, and stage presence through regular practical training.
4. To introduce students to intermediate Bharatanatyam repertoire such as Jatiswaram and improve performance skills.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate dance techniques with precision, balance, posture, and rhythmic accuracy.
CO2	Apply musicality, synchronization, expression, and storytelling in solo and group performances.
CO3	Create dance combinations using choreography principles with confidence, creativity, and stage presence.

Course Contents:

Sr. No.	**Description**	
1.	Introduction to forms and previous year revision	
2.	Choreography on song/ composition	
3.	Application and introduction to emotions for better understanding of movements	4
4.	Rhythm and rhythmic movements	
5.	Introduction to different forms other than the teaching format	
6.	Insights to choreographies and partner motions in folk forms	4
7.	Mock performance training and presentation with costumes	
	TOTAL	

Text Books:

1. Bharata Muni, "Natya Shastra", translated by Manomohan Ghosh, Asiatic Society, Kolkata.
2. Nandikeshvara, "Abhinaya Darpana", translated by Manomohan Ghosh.
3. Balasaraswati, T., "Bharatanatyam", Madras Music Academy.
4. Krishna Iyer, E., "Bharatanatyam", Ganesh & Co., Chennai.

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Reference Books:

1. Kothari, Sunil, "Bharatanatyam", Marg Publications, Mumbai.
2. Vatsyayan, Kapila, "Classical Indian Dance in Literature and the Arts", Sangeet Natak Akademi.
3. Subramaniam, Padma, "Bharata's Art: Then and Now", Bharata Ilango Foundation.
4. Vatsyayan, Kapila, "Indian Classical Dance", Publications Division, Government of India.
5. Srinivasan, Priya, "Sweating Saris: Indian Dance as Transnational Labor", Temple University Press.
6. Sangeet Natak Akademi, "Bharatanatyam – A Reader", Sangeet Natak Akademi, New Delhi.

E-Resources:

1. https://youtu.be/XONKu803dAk?si=LkLbNKPUvKpfZJkF
2. https://youtu.be/D0Ow529EHSo?si=upTtBpNp1lODzHMq
3. https://youtu.be/JDfYT3Ax7mE?si=Q9VYWj95cnLikw2V
4. https://youtu.be/GcZJMiHds3U?si=AXAMwJ37YuDEVbTF
5. https://youtu.be/2j9KmG25l8g?si=zH9rKV-VY7RPirgD

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Liberal Learning – III (Synthesizer/Keyboard)						**Code:** 25RACC305E			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Keyboard musical instrument.

Course Objectives:

1. To strengthen students' understanding and practical application of major/minor scales, chords, chord progressions, and inversions.
2. To develop skills in Western Staff Notation, accompaniment techniques, melody integration, and left-hand coordination.
3. To enhance technical proficiency, musical expression, rhythmic accuracy, ensemble coordination, and stage confidence.

Course Outcomes:

CO1	Apply scales, chords, chord progressions, and inversions in keyboard performance.
CO2	Perform musical compositions using Indian and Western Staff Notation with suitable accompaniment techniques.
CO3	Demonstrate technical proficiency, musical interpretation, ensemble coordination, and stage confidence.

Course Contents:

Sr. No.	**Description**	
1.	Revision of all Major Scales	
2.	Revision of all Minor Scales (Natural, Harmonic & Melodic)	
3.	Revision of Major and Minor Chords,	
4.	Revision of Chord Progression, Family chords, Chords Inversion	
5.	Playing Simple Songs with Indian Notation	
6.	Introduction to Staff Notation	
7.	Understanding the Difference between Indian and Western Staff Notation	
8.	Reading and Playing Simple Melodies from Staff Notation	02
9.	Playing Songs using Both Indian and Staff Notation	
10.	Fundamentals of Keyboard Accompaniment	
11.	Accompaniment using Major and Minor Chords	
12.	Accompaniment with Scales and Simple Songs	02
13.	Group Performance	02
TOTAL		**26**

Text Books:
1. Aaron, M., "Michael Aaron Piano Course – Grade 2", Alfred Music. 2. Thompson, J., "John Thompson's Modern Course for the Piano – Second Grade", Willis Music. 3. Hanon, C. L., "The Virtuoso Pianist in Sixty Exercises", G. Schirmer. 4. Agay, D., "Learning to Play Piano – Book 2", Yorktown Press.
Reference Books:
1. Thompson, J., "Modern Course for the Piano", Willis Music. 2. Aaron, M., "Piano Course", Alfred Music. 3. Hanon, C. L., "The Virtuoso Pianist", G. Schirmer. 4. Harrison, M., "Contemporary Music Theory", Hal Leonard. 5. ABRSM, "Music Theory in Practice (Grades 1–5)", Associated Board of the Royal Schools of Music.
E-Resources:
1. https://www.youtube.com/watch?v=5nA245TZvBY 2. https://www.youtube.com/watch?v=h4YGP7GyZNU&list=PLUPHIkAcHm-SvoAmFIkec2STxRdvJnYYF

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Liberal Learning – III (Basketball)						**Code:** 25RACC305F			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop fundamental basketball skills, physical fitness, teamwork, and understanding of rules and strategies to enable effective participation and performance in the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate basic basketball skills such as dribbling, passing, shooting, and defensive fundamentals effectively.
CO2	Apply offensive and defensive strategies, including transition play, during gameplay and scrimmages.
CO3	Understand and implement basketball game rules and referee gestures accurately in practical situations.

Course Contents:

Sr. No.	**Description**	
1.	**Fundamentals Skill Review:** Refresh all core basketball skills. Perform all basic techniques confidently.	
2.	**Skill Circuit:** Practice all basic skills in rotation. Improve overall basketball fundamentals.	
3.	**Small Group Practice:** Apply skills in partner and group activities. Work effectively with teammates.	02
4.	**Player Stance & Footwork:** Improve movement and body balance. Apply proper stance during movement.	
5.	**Passing Under Movement:** Practice passing while changing positions. Execute accurate passes while moving.	
6.	**Dribbling Around Cones:** Improve control through obstacle drills. Maintain dribbling control in different directions.	
7.	**Assessment- V**	
8.	**Shooting Practice:** Practice shooting from different spots. Improve shooting accuracy.	
9.	**Rebounding Drills:** Practice timing and ball recovery. Perform effective rebounding.	02
10.	**Individual Defense:** Practice defensive movement in simple drills. Apply defensive techniques effectively.	02

11.	**Body Technique:** Improve body positioning and balance. Demonstrate better body control.	
12.	**Combined Fundamental Drills:** Integrate all basketball skills. Execute skills smoothly in sequence, Practice skills with a partner. Improve teamwork and communication	
14.	**Assessment – VI**	02
	TOTAL	**26**

Text Books:

1. FIBA, "Official Basketball Rules", International Basketball Federation (FIBA)
2. Dr. James Naismith, "Basketball: Its Origin & Development",
3. John R. Wooden, "Practical Modern Basketball", Allyn & Bacon

Reference Books:

1. James Naismith – Basketball: Its Origin and Development – University of Nebraska Press.
2. Jerry V. Krause & Don Meyer – Basketball Skills & Drills – Human Kinetics

E-Resources:

1. Rules of Basketball : How to Play Basketball : Basketball Rules for Beginners
2. How To Dribble A Basketball For Beginners! Basketball Basics for Kids Basketball Training
3. How To Shoot A Basketball For Beginners! Basketball Basics [SECRETS]
4. Basketball: Rebounding

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Liberal Learning – III (Cricket)						**Code:** 25RACC305G			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop basic cricket skills. Fitness, teamwork, and knowledge of rules and strategies for effective game performance.

Course Outcomes: After completion of this course, students will be able to -

CO1	Analyze batting, bowling, fielding, and match strategies across T20, ODI, and Test cricket formats.
CO2	Apply tactical decision-making, leadership, field placements, and performance analysis during competitive matches.
CO3	Demonstrate effective cricket performance by integrating sports psychology, nutrition, injury prevention, and technology in match situations.

Course Contents:

Sr. No.	**Description**	
1.	**Batting Strategies:** Build innings in different formats	
2.	**Bowling Plans:** Field settings and tactical bowling	
3.	**Captaincy & Leadership:** Decision-making and leadership	
4.	**Match Strategy:** Powerplay, middle overs, death overs	02
5.	**T20 Cricket Strategies:** Aggressive tactics	02
6.	**ODI Cricket Strategies / Test Cricket Strategies:** Rotation of strike and partnerships / Patience and long-form tactics	
7.	**Assessment – V**	
8.	**Advanced Field Placements:** Offensive and defensive setups	
9.	**Sports Psychology:** Confidence and concentration	
10.	**Nutrition for Cricketers:** Performance nutrition	
11.	**Injury Prevention & Recovery:** Basic sports medicine	
12.	**Technology in Cricket:** DRS, Hawk-Eye, performance analysis	02
13.	**Assessment – VI**	02
	TOTAL	**26**

Text Books:

1. Sanjay Manjrekar, "Cricket Fundamentals", Orient BlackSwan
2. Ravi Shastri, "Winning Cricket: Skills and Strategies", Notion Press
3. R. Sridhar, "Coaching Beyond", Rupa Publications India

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Reference Books:
1. Rob Eastaway, "Cricket Explained: From Grubbers to Googlies", St. Martin's Griffin 2. Surendra Shrivastava, "Cricket – Khel Aur Niyam", Prabhat Prakashan
E-Resources:
1. Sports and Performance Nutrition, IIT Madras, https://onlinecourses.nptel.ac.in/noc24_hs82/ 2. How to Play Cricket 3. Cricket rules explained in 2 minutes 4. Every Cricket Shot Explained in 21 Minutes

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Liberal Learning – III (Rifle and Pistol Shooting)						**Code:** 25RACC305H			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop safe shooting skills, accuracy concentration, and proper shooting techniques in students. It also aims to build discipline, confidence and prepare shooters for competitive events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, physical coordination, and shooting posture.
CO3	Apply mental focus, concentration, and scientific principles to improve shooting performance.
CO4	Demonstrate sportsmanship, discipline, and overall proficiency in competitive shooting.

Course Contents:

Sr. No.	**Description**	
1.	**Recoil Management:** How to avoid recoil	
2.	**Loading and Unloading Procedures: P**rocedure to load a gun.	
3.	**Malfunction Identification and Clearance:** What is malfunction and its solutions	
4.	**PGun Cleaning and Maintenance:** Process to open a gun and clean it	
5.	**Ammunition Types and Selection:** Selecting a perfect ammunition from different ammunition companies	
6.	**Environmental Effects on Shooting:** Effect on a shot of environment	
7.	**Assessment – V**	02
8.	**Scoring Systems:** How to read score.	
9.	**Competition Rules:** Explaining the rules and commands	02
10.	**Match Preparation:** Physical and mental preparation of a shooter for match	02
11.	**Mental Conditioning and Concentration:** Making a shooter mentally strong and increasing concentration process	02
12.	**Time-Controlled Shooting:** Procedure to fire a shot in given time	
13.	**Assessment – VI**	
TOTAL		

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Text Books:

1. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
2. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America
3. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

Reference Books:

1. National Rifle Association (NRA), "The Fundamentals of Rifle Marksmanship", National Rifle Association of America
2. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
3. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America
4. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

E-Resources:

1. Introduction to Exercise Physiology & Sports Performance, IIT Madras, https://nptel.ac.in/courses/109106406
2. Open Sight Air Rifle Shooting Sports For Beginners. @TheGunzoneNetwork - YouTube
3. Basics of the Standing Position | Sauer Academy
4. The Ideal Air Rifle Shooter with Abhinav Bindra [IND]

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Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** III	
Course: Liberal Learning – III (Volleyball)								**Code:** 25RACC305I	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To equip participants with the essential skills and knowledge of volleyball, enabling them to perform fundamental techniques, understand basic rules, and participate in basic gameplay scenarios confidently.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, physical coordination, and shooting posture.
CO3	Apply concentration, mental focus, and scientific principles to improve shooting performance.
CO4	Demonstrate discipline, sportsmanship, and overall proficiency in competitive shooting.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Double Blocking Technique:** Introduction to double blocking, stance and ready position, footwork for lateral movement, timing the jump with the attacker, hand positioning over the net, coordination between middle and wing blocker, drills on blocking angles and recovery.	02
2.	**Advance Digging:** Advanced defensive posture, digging against hard-driven spikes, rolling and diving techniques, pancake save, anticipation and reading the attacker, transition from defense to offense, reaction drills**.**	02
3.	**Advance Setting:** Jump setting, back setting, quick setting, setting accuracy under pressure, decision-making, communication with hitters, setter movement and transition drills.	02
4.	**Cross Court And Line Spiking:** Approach mechanics, body positioning, wrist action, cross-court attack, line attack, shot placement, attacking against blockers, controlled hitting drills**.**	02
5.	**Advanced Blocking:** Single, double and triple blocking strategies, reading setter intentions, block coverage, penetration over the net, and transition after blocking, tactical blocking drills.	02
6.	**Libero Skills:** Role and responsibilities of the libero, serve receive, defensive positioning, emergency setting, court communication, floor defense techniques, specialized libero drills.	02

7.	**Assessment – V**	02
8.	**Offensive Systems (5-1):** Introduction to the 5–1 offensive system, player rotations, setter responsibilities, transition from defense to offense, positional responsibilities, team coordination.	02
9.	**Offensive Combinations:** Quick attacks, tandem attack, slide attack, combination plays, synchronization between setter and attackers, offensive communication and execution drills.	02
10.	**Team Defensive System:** Perimeter defense, rotational defense, block-defense coordination, defensive coverage, court positioning, communication, transition to counterattack.	02
11.	**Tactical Serving:** Float serve and jump serve placement, serving strategies against different formations, targeting weak receivers, serving under pressure, tactical decision-making.	02
12.	**Competitive Match Practice:** Full competitive matches following official rules, tactical implementation, referee signals, teamwork, leadership, sportsmanship, and post-match performance evaluation.	02
13.	**Assessment – VI**	02
	TOTAL	**26**

Text Books:

1. Fédération International de Volleyball (FIVB), "Official Volleyball Rules", FIVB Publications
2. Bonnie Kenny & Cindy Gregory, "Volleyball: Steps to Success", Human Kinetics
3. Anita Bean, "The Complete Guide to Sports Nutrition", Bloomsbury Sport
4. Ian Jeffreys, "The Warm-Up", Human Kinetics

Reference Books:

1. Pete Waite, "Aggressive Volleyball", Human Kinetics
2. Bob Bertucci, "Volleyball Drill Book", Human Kinetics

E-Resources:

1. Volleyball Rules : How to Play Volleyball : The Rules of Volleyball EXPLAINED!
2. 6 Basic Skills in Volleyball - YouTube
3. Everything You Need to Know About the Game of Volleyball - YouTube

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Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** III			
Course: Liberal Learning – III (Football)						**Code:** 25RACC305J			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To enhance football players' technical skills, tactical understanding, physical fitness, teamwork, and sportsmanship, fostering a comprehensive understanding and appreciation of the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain attacking, defensive, formation, and set-piece principles in football.
CO2	Apply possession, counter-attacking, and transition strategies in match situations.
CO3	Analyze performance using psychology, nutrition, injury management, and technology.
CO4	Demonstrate teamwork, decision-making, and tactical skills during matches.

Course Contents:

Sr. No.	**Description**	
1.	**Principles of Attack:** Understand and apply the principles of attack, including creating space, supporting teammates, progressing the ball, and creating goal-scoring opportunities.	
2.	**Principles of Defense**: Understand and apply the principles of defense, including pressure, cover, balance, marking, and communication to effectively prevent opponents from scoring.	02
3.	**Team Formations:** Understand and apply different team formations to improve player positioning, tactical organization, and overall team performance.	
4.	**Transition Play:** Understand and apply effective transition play by quickly switching between attacking and defensive phases to maintain team advantage.	
5.	**Possession-Based Football:** Develop possession-based football skills by improving ball retention, passing accuracy, movement, and decision-making to control the game effectively.	
6.	**Counter-Attacking Football:** Understand and apply counter-attacking principles by transitioning quickly from defense to attack through speed, movement, and effective decision-making.	02
7.	**Assessment-V**	02
8.	**Set-Piece Organization**: Understand and apply set-piece organization by developing effective attacking and defensive strategies for free kicks, corners, and restarts.	02

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9.	**Sports Psychology**: Develop mental skills such as confidence, focus, motivation, resilience, and decision-making to enhance football performance and overall sporting attitude.	
10.	**Injury Management**: Understand basic injury management practices, including prevention, immediate care, recovery strategies, and safe return-to-play procedures for football players.	02
11.	**Technology in Football:** Understand the role of technology in football by exploring tools for performance analysis, player development, match decisions, and injury prevention.	02
12.	**Full Match Analysis:** Analyze full match performance by evaluating tactics, player decisions, team organization, strengths, and areas for improvement.	02
13.	**Assessment-VI**	2
	TOTAL	**26**

Text Books:

1. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA
2. International Football Association Board (IFAB), "Laws of the Game", IFAB

Reference Books:

1. Charles Hughes, "The Winning Formula in Soccer", Meyer & Meyer Sport
2. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA
3. International Football Association Board (IFAB), "Laws of the Game", IFAB

E-Resources:

1. Udemy – Soccer Courses - https://www.udemy.com/topic/soccer/
2. Beginner's guide to football | Football for dummies
3. Every position in soccer explained
4. Rules Of Soccer : How to play Soccer : Soccer Rules for Beginners

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Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** III	
Course: Internship – I								**Code:** 25RAIN301	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 4 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified

students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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SYLLABUS

SEMESTER - IV

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation Engineering)						**Semester:** IV			
Course: Robot Kinematics & Dynamics						**Code:** 25RAPC405			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Engineering Physics, Engineering Mathematics, Engineering Mechanics.

Course Objectives:

1. Select the type of mechanism for the robotic applications
2. Perform kinematic analysis, synthesis of mechanisms.
3. Perform forward and inverse kinematics of robots
4. Apply design procedure for mechanical grippers depending upon their types and mechanism
5. Design of robot manipulators based on dynamic analysis
6. Understand angular velocity and velocity kinematics in robotic systems.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand and analyze basic mechanisms and kinematic chains.
CO2	Analyze velocity and acceleration in mechanisms using kinematic methods.
CO3	Apply principles of rotation and motion kinematics.
CO4	Analyze robot kinematic chains using standard conventions
CO5	Solve forward and inverse kinematics problems in robotic systems.
CO6	Analyze angular and velocity kinematics of rigid robotic links.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Robot Mechanisms:** Kinematic Link, Types of links, Kinematics pair, Types of constrained motion, Classification of Kinematics pairs, Kinematics chain, Degrees of freedom of mechanisms, Inversion of mechanism, Analysis of mechanisms such as Gear trains, cams and followers, belt drives, four bar mechanism, slider crank mechanism etc. Computer aided analysis and synthesis of coupler curves for four bar/five bar mechanism and slider crank mechanisms.	07
2.	**Forward Kinematics:** Robot kinematics-Types- 2D, 3D Transformation, D-H Representation, Displacement Matrices for Standard Configurations, Forward kinematics of Manipulators up to 6 degrees of freedom.	05
3.	**Inverse Kinematics:** Inverse kinematics analysis of robot with standard configurations, methods for solution of non-linear simultaneous equations, use of meta-heuristics for inverse kinematic solutions.	07

4.	**Robot End Effectors:** Types of end effectors, mechanical grippers, vacuum grippers, magnetic grippers, adhesive grippers, tools. Force analysis, the robot end effectors interface, considerations in gripper selection and design.	07
5.	**Robot Arm Dynamics:** Robot dynamics – Rigid body dynamics, Newton-Euler formation, Lagrange-Euler, formation, generalized D'Alembert equations of motion, Simulation using dynamics equations.	07
6.	**Motion Control and Trajectory Planning:** Joint space and task space trajectory generation, Cubic and quintic polynomial interpolation, Real-time motion planning basics, Introduction to dynamics-based control (Feed forward control), Simulating dynamics using MATLAB/Simulink or Python	06
	TOTAL	**39**

Text Books:

1. Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
2. Ratan S. S.,"Theory of Machines", Tata McGraw HillEducation.
3. Bansal R.K., "Textbook of Theory of Machines", Laxmi publications.
4. Deb S.R., "Robotics", Tata McGraw Hill Publications, New Delhi.
5. Balaney, "Theory of Machines", Khanna Publications.

Reference Books:

1. Reza N. Jazar, "Theory of Applied Robotics, 2ed.", Springer.
2. Bruyninckx H., "Robot Kinematics and Dynamics", Katholieke Universiteit Leuven
3. T. Beven,Theory of Machines, Pearson Education, India.
4. Joseph E Shigley and John Uicker, Theory of Machines, McGrawHill.

E-Resources:

1. NPTEL – Introduction to Robotics
   https://nptel.ac.in/courses/112104298
2. SWAYAM – Mechatronics and Robotics
   https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed116

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E-Resources:
3 Modern Robotics (Northwestern University) https://modernrobotics.northwestern.edu 4 ROS Robotics Learning Platform https://docs.ros.org **5** IEEE Xplore Digital Library Robot Arm Kinematics, Dynamics, and Control https://ieeexplore.ieee.org/document/1653917 6 Virtual Labs- RoboDK Robot Simulation Software https://robodk.com 7 Underactuated Robotics Massachusetts Institute of Technology https://underactuated.csail.mit.edu/index.html

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Program: B. Tech. (Robotics and Automation Engineering)				**Semester:** IV					
Course: Robot Kinematics & Dynamics Lab				**Code:** 25RAPC405P					
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites:

Engineering Physics, Engineering Mathematics, Engineering Mechanics.

Course Objectives:

1. To understand kinematic links, pairs, mechanisms, and robotic joints.
2. To analyze velocity, acceleration, and DH parameters of robotic manipulators.
3. To perform forward and inverse kinematic analysis using simulation tools.

Course Outcomes: After completion of this course, students will be able to -

CO1	Analyze robotic links, joints, and mechanisms.
CO2	Determine velocity, acceleration, and DH parameters of manipulators.
CO3	Perform forward and inverse kinematic analysis using simulation software.

Course Contents:

Exp. No.	**Description**	**Duration (Hrs.)**
1.	Studyof Kinematic Links, Pairs and Robotic Joint system using models on each.	02
2.	Demonstration of Four Bar Mechanisms.	04
3.	Velocity and Acceleration Analysis of a Robotic Systems.	04
4.	Find the DH Parameter for a particular joint configuration and number manipulators.	04
5.	Experiment on Robot forward kinematic analysis using simulation software like RoboAnalyzer, RobotDK, CoppeliaSim.	04
6.	Experiment on Robot inverse kinematic analysis using simulation software like RoboAnalyzer, RobotDK, CoppeliaSim.	04
7.	Experiment on Robot Workspace and End-Effector Trajectory Analysis using simulation software such as RoboAnalyzer, RoboDK, or CoppeliaSim.	02
8.	Experiment on Robot Jacobian and Singularity Analysis for a given robotic manipulator using analytical calculations and simulation software.	02
TOTAL		**26**

Reference Books:

1. Hartenberg and Denavit, "Kinematics and Synthesis of Linkages", McGraw Hill Book Co.
2. Bruyninckx H., "Robot Kinematics and Dynamics", Katholieke Universiteit Leuven.
3. Reza N. Jazar, "Theory of Applied Robotics, 2ed.", Springer.
4. Deb S.R., "Robotics", Tata McGraw Hill Publications, New Delhi.

E-Resources:

Robotics and Control Systems Simulation Virtual Lab: http://vlabs.iitkgp.ernet.in/rcs/#

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Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Sensors & Instrumentation						**Code:** 25RAPC406			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Basic Electrical Engineering, Basic Electronics Engineering, Physics, Engineering Mathematics

Course Objectives:

1. Familiarity with sensor principles and Technologies
2. Master Sensor interfacing and signal conditioning
3. Explore Sensor Fusion and Integration
4. Examine Applications of Sensor Technology
5. Explore Emerging Trends and Future Directions

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the fundamental concepts of measurement systems.
CO2	Understand the role of sensors in various robotic applications such as industrial automation, autonomous navigation, and manipulation tasks.
CO3	Understand the working principles and characteristics of motion, proximity, and temperature sensors
CO4	Analyze sensor data to evaluate the performance and reliability of sensors in specific robotic tasks and environments (Force, Torque etc.)
CO5	Understand the role of Intelligent Instrumentation and Acquisition Systems
CO6	Understand recent advancements in sensor technologies for robotic

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Measurement & Sensors:** Basics of measurement systems, Definition of sensor and transducer, Types of errors and error analysis, Static and dynamic characteristics of transducers, Sensor classification and calibration techniques, Sensor output signal types.	07
2.	**Robot Sensors:** Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors - Photo Electric Sensors, Position sensors – Piezo Electric Sensor. Resolvers, Encoders – Absolute and Incremental: - Optical, Magnetic, Capacitive, Pneumatic position sensors.	07
3.	**Motion, Proximity & Temperature Sensors:** Potentiometers, encoders, resolvers, Inductive, capacitive, magnetic sensors, LVDT, RVDT, accelerometers, GPS, Bluetooth, ultrasonic, light detector and ranging (LIDAR)	06

	Definition of Temperature: Thermal Energy, absolute and relative Temperature, Resistance-Temperature Detectors (RTD), Thermistors, Thermistor Characteristics, thermocouples, Thermoelectric Effects, Characteristics, Thermocouple Sensors, seebeck effect and peltier effect.	
4.	**Force, Torque, and Tactile Sensors:** Strain gauge principles and Wheatstone bridge, Load cells, piezoelectric force sensors, Tactile sensors and slip detection, Torque measurement for robotic manipulators, Gripper and end-effector sensor integration.	06
5.	**Instrumentation Systems and Data Acquisition:** Block diagram of instrumentation system, Signal conversion: ADC, DAC, sampling, and quantization, Data acquisition systems (DAQ), multiplexing, Noise reduction and grounding techniques. Interfacing sensors with Microcontrollers (e.g., Arduino, Raspberry Pi).	06
6.	**Advancement in Sensors for Robotics:** Flexible and Wearable Sensors- Printed electronics and soft robotics integration **Types**: Stretchable strain sensors, e-skin (electronic skin), tactile fabrics, Bio-Inspired Sensors - Mimicking human/animal sensory systems, **Types**: Artificial retina, Bio-mimetic tactile sensors, Olfactory (gas) sensors mimicking smell, AI-Enabled Sensors (Edge AI) -Sensors with AI/ML algorithms embedded for real-time decision-making at the edge, Supports deep learning inference, Examples: Google Coral, NVIDIA Jetson, EdgeTPU-based sensors, Wireless and IoT-Enabled Sensors - Wireless protocols (ZigBee, BLE, LoRa, Wi-Fi 6), Cloud-based data logging.	07
	TOTAL	**39**

Text Books:

1. Sawhney A. K., "Electrical and Electronics Measurements and Instrumentation", Dhanpat Rai & Sons, 4th Edition, 1994.
2. D. Patranabis, "Sensors and Transducers", Prentice Hall India Learning Private Limited, 2nd Edition.
3. Ernest. O. Doebelin, Danish N. Manik, "Measurement Systems", 2019, 7th Edition, McGraw Hill Book co.

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Reference Books:

1. Andrzej M. Pawlak, "Sensors and Actuators in Mechatronics: Design and Applications", CRC Press.
2. Ricardo Suárez Fernández, "Fundamentals of Industrial Automation".
3. B. C. Nakra and K. K. Chaudhary, "Instrumentation, Measurement and Analysis", McGraw Hill Education India Private Limited, 4th Edition.
4. John G. Webster, "Instrumentation and Sensors Handbook", CRC Press, 1st Edition, 1999.
5. D. V. S. Murty, "Transducers and Instrumentation", PHI Learning Pvt. Ltd., 2010.
6. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw-Hill, Third Edition.
7. Curtis D. Johnson, "Process Control Instrumentation Technology", Prentice Hall International Edition, 6th Edition.

E-Resources:

1. NPTEL – Sensors and Actuators
   https://nptel.ac.in/courses/108105064?utm_source=chatgpt.com
2. SWAYAM – Sensors and Instrumentation Courses
   https://onlinecourses.swayam2.ac.in/e-learning/preview/nou24_bt02
3. IEEE Xplore Digital Library
   https://ieeexplore.ieee.org/document/1213680
4. Virtual Labs (MoE, IITs) – Sensors and Instrumentation Lab
   https://sil-coep.vlabs.ac.in/
5. Wokwi Online Arduino Simulator
   https://wokwi.com
6. Stanford University Sensors and Sensor Systems
   https://online.stanford.edu/courses/me220-introduction-sensors

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Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Sensors & Instrumentation Lab						**Code:** 25RAPC406P			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites:

Basic Electrical Engineering, Basic Electronics Engineering, Physics, Engineering Mathematics

Course Objectives:

1. Understand measurement systems, sensors, and their operating principles.
2. Perform measurements of position, speed, temperature, force, vibration, and acceleration using different sensors.
3. Understand sensor interfacing and data acquisition systems for automation applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify and explain different measurement systems and sensors.
CO2	Measure physical parameters using appropriate sensors and instrumentation.
CO3	Interface sensors with data acquisition systems for automated measurement.

Course Contents:

Exp. No.	**Description**	**Duration (Hrs.)**
Any Eight Experiments from the following		
1	Study of Measurement System Components	02
2	Measurement of speed and displacement using linear sensors	02
3	Position Sensing Using Potentiometer and Encoder	02
4	Proximity Sensing Using Inductive and Capacitive Sensors	02
5	Measurement of temperature using thermistor (whetstone Bridge)	02
6	Study of photo sensors.	02
7	Temperature Measurement Using Thermocouple & RTD	02
8	Force Measurement Using Strain Gauge and Load Cell	04
9	Vibration and acceleration measurements using piezo electric sensor.	04
10	Studyon data acquisition systems and interfacing sensors with computer	04
	Total	**26**

Reference Books:

1. D. Patranabis, "Sensors and Transducers", Prentice Hall India Learning Private Limited, 2nd Edition.
2. Ernest. O. Doebelin, Danish N. Manik, "Measurement Systems", 2019, 7th Edition, McGraw Hill Book co.
3. John G. Webster, "Instrumentation and Sensors Handbook", CRC Press, 1st Edition, 1999.
4. D. Patranabis, "Principles of Industrial Instrumentation", Tata McGraw-Hill, Third Edition.

E-Resources:

Sensors and Instrumentation Lab: https://sil-coep.vlabs.ac.in/List%20of%20experiments.html
Sensors Modeling & Simulation Lab: https://sl-coep.vlabs.ac.in/List%20of%20experiments.html

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation Engineering)						**Semester:** IV			
Course: Advance Manufacturing Technology.						**Code:** 25RAPC407			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	-	03	40	60	-	-	-	100

Prerequisites:

Physics, Chemistry, Engineering materials, Smart materials, Strength of material.

Course Objectives:

1. To provide a comprehensive understanding of both conventional and advanced manufacturing processes.
2. To connect manufacturing principles to the design and fabrication of robotic components and systems.
3. To enable students to evaluate and choose appropriate manufacturing processes for robotic applications.
4. To expose learners to modern trends including CNC, Additive Manufacturing, Automation, and Industry 5.0.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand conventional and modern manufacturing processes for robotic components.
CO2	Explain forming, casting, and machining techniques to fabricate robot links and frames.
CO3	Explain the concept of non-traditional processes for complex parts such as robotic joints or grippers.
CO4	Demonstrate CAD/CAM and CNC for robot part manufacturing.
CO5	Evaluate additive and hybrid manufacturing for rapid prototyping and customization in robotics.
CO6	Analyze automation strategies and Industry 5.0 tools applied in intelligent robotic manufacturing.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Casting and Forming Techniques in Robotic Fabrication:** Overview of Casting: Sand casting, Die casting, Investment casting, Applications in robot base, housing, and structural components, Metal Forming Processes: Forging, Rolling, Extrusion, Deep Drawing, Sheet metal forming for robot body and enclosures, Process selection based on strength, accuracy, and weight	06
2.	**Machining and Welding for Robotic Structures:** Conventional Machining Processes: Lathe, Milling, Drilling, Grinding, Surface finishing and tolerance control for robotic assemblies, Welding Techniques: Arc welding, MIG/TIG welding, Laser welding, Weld joints in robotic arm segments, actuator housings, Automation in machining and welding (robot-assisted)	07

3.	**Non-Traditional Machining for Complex Robotic Components:** Need for non-traditional methods in miniaturized/micro components, EDM (Electrical Discharge Machining), ECM(Electrochemical Machining), Laser Beam Machining (LBM), Ultrasonic Machining (USM), Water Jet Machining (WJM), Tooling, accuracy, and material selection, Applications in sensors housing, precision end-effectors.	06
4.	**CNC and CAD/CAM for Robotic Part Production:** Basics of CNC machines: structure, types, coordinate systems, G & M codes, CNC programming for robotic brackets, links, CAD modeling and CAM integration, Tool path generation and post-processing, Case study: CNC-machined aluminum robotic gripper.	07
5.	**Additive and Hybrid Manufacturing for Robotics:** Introduction to Additive Manufacturing (AM): FDM, SLA, SLS, DMLS, Materials used in AM for robotic applications (plastic, metal, composites), Rapid prototyping and functional part production, Hybrid manufacturing (Additive + Subtractive), Applications in humanoid robotics, wearable exoskeletons, soft robotics	07
6.	**Intelligent Manufacturing and Industry 5.0 in Robotics** Manufacturing Automation: Types and levels, Role of PLC, SCADA, sensors, vision systems, Industry 5.0 concepts: IoT, Digital Twin, Cyber-Physical Systems, Smart Factory and robotic cell integration, Case studies: Manufacturing Industry dealing with robots.	06
	TOTAL	**39**

Text Books:

1. M. P. Groover, "Automation, Production Systems and CIM", Pearson.
2. G. W. Rowe, "Principles of Industrial Metal Working Process", Edward Arnold.
3. Serope Kalpakjian and Steven R. Schmid, "Manufacturing Engineering & Technology", Pearson.
4. R. S. Parmar, "Welding Process and Technology", 2nd Edition, Khanna Publishers.

Reference Books:

1. Amitabha Ghosh and Ashok Kumar Mallik, "Manufacturing Science", Affiliated East-West Press.
2. T. K. Kundra, P. N. Rao and N. K. Tiwari, "Numerical Control and CAD/CAM", Tata McGraw-Hill.
3. V. Jayakumar, "Introduction to Smart Manufacturing", McGraw Hill.
Serope Kalpakjian, "Manufacturing Processes for Engineering Materials", Pearson.

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E-Resources:
1. NPTEL – Manufacturing Processes I & II https://nptel.ac.in/courses/112107144 2. SWAYAM – Manufacturing and Production Courses https://onlinecourses.nptel.ac.in/e-learning/preview/noc26_me47 3. Virtual Labs (MoE, IITs) – Manufacturing Processes Lab https://mp-dei.vlabs.ac.in/ 4. Siemens NX CAD/CAM Learning Edition https://www.siemens.com/en-us/ 5. Carnegie Mellon University Advanced Manufacturing and Robotics https://www.cmu.edu/manufacturing 6. College London Manufacturing Engineering and Robotics https://www.imperial.ac.uk/mechanical-engineering

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Digital Electronics & Microcontrollers						**Code:** 25RAMD402			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
03	-	--	03	40	60	-	-	-	100

Prerequisites:

Basic Electronics & Electrical Engineering

Course Objectives:

1. To acquire the basic knowledge of digital logic levels and application of knowledge to understand digital electronics circuits.
2. To prepare students to perform the analysis and design of various digital electronic circuits.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain and apply Boolean algebra and minimization techniques.
CO2	Analyze combinational and sequential digital circuits.
CO3	Analyze 8051 architecture and memory organization.
CO4	Develop basic 8051 programs using instructions and peripherals.
CO5	Develop 8051 interfacing applications for control systems.
CO6	Evaluate microcontrollers for robotics and automation applications.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Boolean Algebra**: Simplification of Boolean functions - special forms of Boolean functions minterm (SOP) maxterm (POS) - K Map representation of logic functions - simplification of logic functions using K Map – Don't care conditions, Quine McCluskey minimization method.	06
2.	**Sequential & Combinational Digital Circuits:** Sequential circuits – Latches and Flip-flops (D, T, S-R, J-K) shift registers **Combinational Digital Circuits** Half and Full Adders-Half and Full Subtractors - Code converters - Encoder-Decoder - Multiplexer- Demultiplexer - Binary/ BCD adders, subtractors - Carry look ahead adder- parity checker-parity generators- Magnitude comparator.	07
3.	**8051 Microcontroller:** Microprocessor Vs Microcontroller, Embedded Systems, Embedded Microcontrollers, 8051 Architecture- Registers, Pin diagram, I/O ports functions, Internal Memory organization. External Memory (ROM & RAM) interfacing.	07
4.	**8051 Instruction Set and Peripherals:** Addressing Modes, Data Transfer instructions, Arithmetic instructions, Logical	

	Instructions, Branch instructions, Bit manipulation instructions. Simple Assembly language program examples (without loops) to use these instructions. 8051 Timers and Counters – Operation and Assembly language programming to generate a pulse using Mode-1 and a square wave using Mode- 2 on a port pin. 8051 Serial Communication- Basics of Serial Data Communication, RS- 232 standard. Simple Serial Port programming in C to transmit a message and to receive data serially.	07
5.	**Interfacing and Programming:** Interfacing simple switch and LED to I/O ports to switch on/off LED with respect to switch status.8051 C programming to generate a square waveform on a port pin using a Timers. Interfacing 8051 to ADC-0804, DAC, LCD and Stepper motor and their 8051 Assembly language interfacing programming.	06
6.	**Advance Microcontrollers:** ARM architecture overview. ARM Cortex-M4 (STM32) features. AVR (ATmega328): Architecture, features Comparison of 8051, AVR and ARM Difference between Microprocessor and Microcontrollers. Application of Microcontrollers in robotics & automation.	06
	TOTAL	**39**

Text Books:

1. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, "Microelectronic Circuits: Theory and Applications", Seventh Edition, Oxford University Press, 2017.
2. M. Morris Mano, "Digital Logic and Computer Design", PHI, 2000 Edition.
3. Muhammad Ali, "The 8051 Microcontroller and Embedded Systems – Using Assembly and C", PHI / Pearson, 2006.
4. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. Donald A. Neamen, "Semiconductor Physics and Devices", 4th Edition, McGraw Hill, 2017.
2. Ramakant A. Gayakwad, "Opamp and Linear Integrated Circuits", 3rd Edition, PHI, 2007.
3. Manish K. Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014.
4. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.

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E-Resources:
E-book versions are available 1. NPTEL – Introduction To Digital Circuits https://nptel.ac.in/courses/117106086 2. NPTEL-Embedded Systems: Introduction https://nptel.ac.in/courses/108102045 3. SWAYAM – Embedded Systems and Microcontrollers https://onlinecourses.swayam2.ac.in/e-learning/preview/ntr26_ed112 4. Exploring Arduino Board Applications in Embedded Systems https://ieeexplore.ieee.org/document/11063918 5. Virtual Labs (MoE, IITs) – Digital Electronics Lab https://de-iitr.vlabs.ac.in/ 6. University of California, Berkeley Embedded Systems and IoT https://www2.eecs.berkeley.edu/Courses/EEC149/

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)				**Semester:** IV					
Course: Digital Electronics & Microcontrollers Lab				**Code:** 25RAMD402P					
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	25	-	25

Prerequisites:

Basic Electronics & Electrical Engineering

Course Objectives:

1. Understand measurement systems, sensors, and their operating principles.
2. Perform measurements of position, speed, temperature, force, vibration, and acceleration using different sensors.
3. Understand sensor interfacing and data acquisition systems for automation applications.

Course Outcomes: After completion of this course, students will be able to -

CO1	Identify and explain different measurement systems and sensors.
CO2	Measure physical parameters using appropriate sensors and instrumentation.
CO3	Interface sensors with data acquisition systems for automated measurement.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
Any Four from Each Part (Part A and Part B)		
	Part A	
1.	Realization of Half Adder & Full Adder using Basic gates	02
2.	Realization of Half Subtractor & Full Subtractor using Basic gates	02
3.	Implementation of 4x1 multiplexer and 1x4 demultiplexer using logic gates	02
4.	Design and verify Binary to Gray and Gray to Binary conversion using NAND gates only	02
5.	Verify the truth table of RS, JK, T and D flip-flops using NAND and NOR gates	02
	Part B	
1.	Data Transfer: Block Move, Exchange, Sorting, Finding largest element in an array.	02
2.	Arithmetic Instructions - Addition/subtraction, multiplication and division, square, Cube – (16 bits	02
3.	Arithmetic operations – bit addressable).	02
4.	Programs to generate delay, Programs using serial port and on-Chip timer/counter.	02
5.	Interfacing of LED to 8051.	02
6.	Alphanumeric LCD panel and Hex keypad input interface to 8051.	02
7.	DC motor control interface to 8051.	02

8.	Write ALP to interface a Stepper Motor to 8051 to rotate the motor	02
9.	Interfacing of ADC and DAC	02
10.	Matrix Keypad interfacing with 8051.	02
11.	Case studies: Robotic arm control, Line follower robot, home automation, smart sensor node.	02
TOTAL		**26**

Text Books:

1. Adel S. Sedra, Kenneth C. Smith and Arun N. Chandorkar, "Microelectronic Circuits: Theory and Applications", Seventh Edition, Oxford University Press, 2017.
2. M. Morris Mano, "Digital Logic and Computer Design", PHI, 2000 Edition.
3. Muhammad Ali, "The 8051 Microcontroller and Embedded Systems – Using Assembly and C", PHI / Pearson, 2006.
4. Kenneth J. Ayala, "The 8051 Microcontroller", 3rd Edition, Thomson/Cengage Learning.

Reference Books:

1. Donald A. Neamen, "Semiconductor Physics and Devices", 4th Edition, McGraw Hill, 2017.
2. Ramakant A. Gayakwad, "Opamp and Linear Integrated Circuits", 3rd Edition, PHI, 2007.
3. Manish K. Patel, "The 8051 Microcontroller Based Embedded Systems", McGraw Hill, 2014.
4. Raj Kamal, "Microcontrollers: Architecture, Programming, Interfacing and System Design", Pearson Education, 2005.

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OPEN ELECTIVE - II

(Select any one course from the given Open Elective Courses)

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Program: B. Tech. (Common to all Programs)								**Semester:** IV	
Course: Open Elective – II (Cyber Security & Laws)								**Code:** 25ALOE402A	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	40	60	-	-	-	100

Prerequisites:

Foundational knowledge in computer science, networking.

Course Objectives:

1. To introduce the cyber world and cyber law in general.
2. To enhance the understanding of problems arising out of online transactions and provoke them to find solutions.
3. To know the technologies that stand behind certain cyber rimes.
4. To identify and analyze statutory, regulatory, constitutional, and organizational laws that affects the information technology professional.

Course Outcomes: After completion of this course, students will be able to -

CO1	Illustrate and discuss the basic concepts of cyber security, Devices.
CO2	Understand the aspects related to personal data privacy and security.
CO3	Understand the main components of cyber security plan.
CO4	Understand about the type and nature of cyber-crimes.
CO5	Articulate the well-known cyber-attack incidents, explain the attack scenarios, and explain mitigation techniques.
CO6	Explain the difference between Systems Cyber Security, Network Cyber Security, and Cryptography, Crypto-Protocols, etc.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Cyber Security:** Defining Cyberspace and Overview of Computer and Web-technology, Architecture of cyberspace, Communication and web technology, Internet, World wide web, Internet infrastructure for data transfer and governance, Internet society, Regulation of cyberspace, Concept of cyber security.	04
2.	**Digital Devices Security, Tools and Technologies for Cyber Security:** End Point device and Mobile phone security, Password policy, Security patch management, Data backup, Downloading and management of third-party software, Device security policy, Cyber Security best practices, Significance of host firewall, Wi-Fi security, Configuration of basic security policy and permissions.	04

3.	**Cyber security Management, Compliance and Governance:** Cyber security Plan- cyber security policy, cyber crises management plan., Business continuity, Risk assessment, Types of security controls and their goals, Cyber security audit and compliance, National cyber security policy and strategy.	05
4.	**Cybercrimes:** Targeting Computer systems and Mobiles- data diddling attacks, spyware, logic bombs, DoS, DDoS, APTs, virus, Trojans, ransomware, data breach Cybersquatting, Pharming, drug trafficking, human trafficking., Social Media Scams & Frauds- impersonation, identity theft Cyber Police stations, Crime reporting procedure, Case studies	05
5.	**Cybercrime**: Illustrations, Examples and Mini cases, Real-life examples, Mini Cases- Social Engineering Attacks, Illustration of financial frauds in cyber domain, Digital Signature- Related Crime scenarios, Digital forensics case Illustrations, Online scams**.**	05
6.	**Cyber law:** Cybercrime and legal landscape around the world, IT Act,2000 and its amendments. Limitations of IT Act, 2000. Cybercrime and punishments, Cyber Laws and Legal and ethical aspects related to new technologies- AI/ML, IOT, Block chain, Dark net and social media, Cyber Laws of other countries.	05
	TOTAL	**28**

Text Books:

1. Michael E. Whitman, Herbert J. Mattord, (2018), "Principles of Information Security", 6th edition, Cenage Learning, N. Delhi.
2. Chris Reed & John Angel, "Computer Law", OUP, New York, (2007).
3. Prasad R.S., "Cyber Crime an Introduction".
4. Ed. Kumar Krishna, "Cyber Laws".

Reference Books:

1. Angus M. Marshall, "Digital forensics: Digital evidence in criminal investigation", John – Wiley and Sons, 2008.
2. Sushma Arora, Raman Arora, "Cyber Crimes & Laws", 4th Edition 2021, Publisher: Taxmann,
3. N S Nappinai, "Technology Laws Decoded", 1st Edition, Publisher: Lexis Nexis.

E-Resources:

1. https://onlinecourses.nptel.ac.in/noc23_cs127/preview
2. https://onlinecourses.swayam2.ac.in/nou19_cs08/preview
3. https://onlinecourses.nptel.ac.in/noc25_cs116/preview

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)								**Semester:** III	
Course: Open Elective – II (Sustainability and Climate Change)								**Code:** 25ALOE402B	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	40	60	-	-	-	100

Prerequisites:

Students should have knowledge about current environmental issues, various types of pollution and the concept of sustainable development.

Course Objectives:

1. To introduce the fundamental concepts and definitions of sustainability
2. To equip students with knowledge of sustainable construction solutions.
3. To develop an understanding of the Earth's climate system, assess the impacts of climate change, and evaluate the vulnerabilities of natural systems.

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

CO1	Explain the principles, challenges, global agreements, and legislations related to sustainable development and environmental protection.
CO2	Apply green materials, energy-water efficiency strategies, and green building rating systems to develop sustainable infrastructure solutions.
CO3	Analyze the earth's climate system, human influences, and observed trends to understand the fundamentals of climate change.
CO4	Evaluate the causes, impacts, and physical evidence of climate change at global and regional scales.
CO5	Assess the sectoral impacts of climate change on natural systems, infrastructure, and human health.
CO6	Recommend mitigation strategies and policy measures through international frameworks and technological interventions to address climate change.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Sustainable Development:** Definitions & Dimensions: sustainability, Brundtland Report, triple bottom line (economic, social, environmental), Global & Local Environmental Challenges: resource depletion, climate change, pollution, Agenda 21, CDM, Paris/Kyoto Protocols, Clean Development Mechanism, Environmental Legislation & Standards: ISO 14000 series, Indian Water & Air Acts.	05

2.	**Sustainable Solutions:** Green Materials & Techniques: low-VOC paints, agro-waste bricks, bamboo, ferro-cement, stabilized soil blocks. Energy & Water Efficiency: passive design, renewable/solar/wind energy, rainwater harvesting, EIA in construction. Green Building Systems: LEED, GRIHA, ECBC, BREEAM rating frameworks for sustainable infrastructure.	05
3.	**Climate & Climate Change Fundamentals:** Earth's Climate System: Atmosphere structure, energy balance, greenhouse effect, climate zones, monsoons, El Niño/La Niña Human Influence: Greenhouse gas emissions, global warming trends, carbon cycle, RCP/SSP scenarios, Indian climate observations	04
4.	**Climate Change Impact:** Climate Change Impact: Temperature shifts, sea-level rise, extreme weather, glacier melt, urban heat islands, Natural vs. anthropogenic causes; Milankovitch cycles, anthropogenic emissions. Physical evidence: rising global temperatures, melting glaciers, sea-level rise, extreme weather trends in India and globally.	05
5.	**Impacts on Natural System:** Sectoral impacts: agriculture, water resources, infrastructure, coastal zones, urban systems including heat islands, flooding, human health	04
6.	**Mitigation & Policy Measures:** International policy processes: UNFCCC, IPCC, Kyoto/Montreal Protocols, CDM & carbon trading, Technological and engineering mitigation: renewable energy, CCS, reflective surfaces (cool roofs), bioengineering (e.g., slope stabilization)	05
	TOTAL	**28**

Text Books:

1. Gilbert M. Masters and Wendell P. Ela, "Introduction to Environmental Engineering and Science", Pearson Education.
2. D. N. Murty, "Sustainable Development", Himalaya Publishing House.
3. Peter P. Rogers, Kazi F. Jalal, and John A. Boyd, "An Introduction to Sustainable Development", Routledge, Earthscan Series.
4. N. H. Ravindranath and Jayant Sathaye, "Climate Change and Developing Countries", Springer.

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Reference Books:

1. K. S. Jagadish et al., "Alternative Building Materials & Technologies", New Age International Publishers.
2. P. T. Anastas and J. B. Zimmerman, "Principles of Green Engineering", Oxford University Press.
3. David T. Allen and David R. Shonnard, "Sustainability Engineering: Concepts, Design & Case Studies", Pearson Education.
4. S. Kumar Dash, "Climate Change – An Indian Perspective", Cambridge University Press, 2007.
5. John M. Wallace and Peter V. Hobbs, "Atmospheric Science: An Introductory Survey", Elsevier Academic Press, 2006.
6. IPCC Assessments, Intergovernmental Panel on Climate Change (IPCC), as referenced in Anna University syllabus.

E-Resources:

1. UNEP (United Nations Environment Programme)
   https://www.unep.org/resources
2. IPCC (Intergovernmental Panel on Climate Change) Reports
   https://www.ipcc.ch/reports/
3. edX - Sustainability Courses
   https://www.edx.org/learn/sustainability
4. Coursera - Climate Change Courses
   https://www.coursera.org/courses?query=climate%20change
5. NASA Global Climate Change: Vital Signs of the Planet
   https://climate.nasa.gov/
6. World Bank Open Knowledge Repository
   https://openknowledge.worldbank.org/
7. UC Berkeley Environmental Courses (Search for PDFs)
   https://nature.berkeley.edu/classes/
8. MIT Open Courseware - Environmental Topics
   https://ocw.mit.edu/courses/find-by-topic/#cat=environment

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)				**Semester:** IV					
Course: Open Elective – II (Energy Audit and Electrical Safety)				**Code:** 25ALOE402C					
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	40	60	-	-	-	100

Prerequisites:

Concept of power & energy in three phase & single phase, Various electrical equipment & specifications

Course Objectives:

1. To Study the importance of energy security for sustainable development and the fundamentals of energy conservation.
2. To introduce performance evaluation criteria of various electrical and thermal installations to facilitate the energy management
3. To relate the data collected during performance evaluation of systems for identification of energy saving opportunities
4. Understand the key terms and definitions related to electrical safety.
5. Learn about preliminary preparations and preconditions necessary before starting installation work.

Course Outcomes: After completion of this course, students will be able to -

CO1	Illustrate present state of energy security and its importance.
CO2	Identify and describe the basic principles and methodologies adopted in energy audit of utility.
CO3	Illustrate and analyze the Financial Analysis Techniques.
CO4	Evaluating the performance of some common thermal installations and list the energy saving opportunities.
CO5	Demonstrate awareness of the scope and significance of electrical safety in reducing risk and ensuring safe practices in electrical systems.
CO6	Identify and a**ssess** the potential risks and hazards associated with the installation process of electrical equipment.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Energy Scenario:** Commercial and non-commercial energy, primary energy resources, commercial energy production, final energy consumption, energy needs of growing economy, long term energy scenario, energy pricing, energy sector reforms, energy and environment, energy security, energy conservation and its importance, Energy Conservation Act-2001 and its features, Re-structuring of the energy supply sector, energy strategy for the future, air pollution, climate change, Electricity Act, 2003.	05

2.	**Energy Management & Audit:** Definition, need and types of energy audit. Energy management (audit) approach-understanding energy costs, bench marking, energy performance, matching energy use to requirement, maximizing system efficiencies, optimizing the input energy requirements, fuel & energy substitution, energy audit instruments, Facility as an energy system, Energy analysis and the Sankey Diagram, Organizing - location of energy management, top management support, managerial function, roles and responsibilities of energy manager, force field analysis, Energy policies and its purpose.	05
3.	**Financial Management:** Investment-need, appraisal and criteria, financial analysis techniques-simple payback period, return on investment, net present value, internal rate of return, cash flows, risk and sensitivity analysis; financing options, energy performance contracts and role of ESCOs, Defining monitoring & targeting, elements of monitoring & targeting, data and information-analysis, techniques -energy consumption, production, cumulative sum of difference (CUSUM).	05
4.	**Energy Efficiency in Electrical Utilities:** Electrical load management and maximum demand control, power factor improvement and its benefit, selection and location of capacitors, factors affecting motor performance, rewinding and motor replacement issues, energy saving opportunities with energy efficient motors, energy conservation opportunities in Fans, Blower, Pumps, Lighting System.	05
5.	**Introduction to Electrical Safety, Shocks And Their Prevention:** Terms and definitions, objectives of safety and security measures, Hazards associated with electric current and voltage, principles of electrical safety, Primary and secondary electrical shocks, causes of electrical shock and its severity, medical analysis of electric shocks and its effects, shocks due to flash/ Spark over's, prevention of shocks, safety precautions against contact shocks, flash shocks, burns in residential buildings and shops.	04
6.	**Safety During Installation of Plant and Equipment:** Introduction, preliminary preparations, preconditions for start of installation work, risks during installation of electrical plant and equipment, safety aspects during installation, field quality and safety during erection, personal protective equipment for erection personnel, installation of a large oil immersed power transformer, installation of outdoor switchyard equipment, safety during installation of electrical rotating machines.	04
TOTAL		**28**

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Text Books:

1. Energy Audit and Management, Volume-I, IECC Press.
2. W.R. Murphy, G. McKay Butter worth," Energy management", Elsevier/bsp Books Pvt. Ltd., 2003.
3. Gupta B. R.: Generation of Electrical Energy, Eurasia Publishing House Pvt. Ltd., New Delhi, 2001
4. Prasanna Chandra, "Financial management", Tata McGraw Hill, 10th Edition, 2019.
5. Rao, S. and Saluja, H.L., "Electrical Safety, Fire Safety Engineering and Safety Management", Khanna Publishers, 1988.

Pradeep Chaturvedi, "Energy Management Policy, Planning & Utilization", Concept Publishing.

Reference Books:

1. Albert Thumann, P.E., C.E.M. William J. Younger, "Handbook of Energy Audits", River Publishers,
2. Paul O'Callaghan, "Energy management", McGraw-Hill Education, 1992.
3. CB Smith, "Energy Management Principles", Pergamon Press, New York.
4. W. C. Turner, "Energy Management Hand Book". John Wiley and sons.

E-Resources:

1. NPTEL course on Basic Principles of Energy Management & Energy Audit, By Dr. R. N. Patel & Dr. Akhilesh Kumar Tiwari, Chhattisgarh Swami Vivekanand Technical University, Bhilai. Basic Principles of Energy Management & Energy Audit - Course
2. NPTEL course on Building Energy Systems and Auditing, By Prof. Shankha Pratim Bhattacharya, IIT Kharagpur. Building Energy Systems and Auditing - Course

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Common to all Programs)								**Semester:** IV	
Course: Open Elective – II (Digital Marketing)								**Code:** 25ALOE402D	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	40	60	-	-	-	100

Prerequisites:

Fundamentals of Business, Digital Tools

Course Objectives:

1. To understand digital marketing & process of website design.
2. To identify the keywords for a website & understand the SEO.
3. To Study the various Digital Marketing Tools.
4. To learn the use of social media websites for Digital Marketing.
5. To be Conversant with Linked In platform.
6. To know the recent trends in Digital Marketing.

Course Outcomes: After completion of this course, students will be able to -

CO1	Design websites using free tools like word press and explore it for digital marketing.
CO2	Apply various keywords for a website & to perform SEO.
CO3	Understand the various SEM Tools and implement the Digital Marketing Tools.
CO4	Illustrate the use of Facebook, Instagram and YouTube for Digital Marketing in real life.
CO5	Use Linked in platform for various campaigning.
CO6	Understand the importance of recent trends in digital marketing.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Digital Marketing Planning and Structure:** Importance of Digital Marketing, Digital Marketing Vs. Traditional Marketing, Inbound vs Outbound Marketing, Understanding Demographics. WWW, Buying a Domain, Core Objective of Website and Flow, One Page Website, Strategic Design of Products & Services Page, Strategic Design of Landing Page, Segmentation & Targeting and Positioning to Digital Marketing, Portfolio, Gallery and Contact Designing Wordpress Website.	04
2.	**Search Engine Optimization (SEO):** Fundamentals; Keywords and SEO Content Plan; SEO & Business Objectives; Writing SEO Content; On-site & off-site SEO; Optimize Organic Search Ranking, Website SEO Auditing. Introduction to Web Analytics.	04

3.	**Search Engine Marketing:** Importance of Adwords, Google Ad Types, PPC Cost Formula, Ad Page Rank, Billing and Payments, Adwords User Interface, Keyword Planner, Creating Ad Campaigns, Creating Text Ads, Creating Ad Groups, Search Engine Marketing (SEM) Tools, Bidding Strategy for CPC. Case Studies. Conversion Tracking Code, Designing Image Ads, Creating Video Ads, Youtube Video Promotion	05
4.	**Social Media Marketing (SMM) Part 1:** **B to C Perspective, B to B Perspective:** Introduction; Major Social Media Platforms for Marketing; Developing Data-driven Audience & Campaign Insights; Social Media for Business. **Facebook & Instagram Marketing:** Understanding of Facebook Marketing, Types of Facebook Advertising, Creating first ad on Facebook, Setting Campaign and optimization, Facebook Power Editor, Facebook Video Marketing, Facebook App & Shopping Marketing. **Youtube Marketing:** YouTube Account Setup (Create a business account with a personal account), YouTube Monetization, YouTube Ads, YouTube Analytics.	05
5.	**Social Media Marketing (SMM) Part 2:** **LinkedIn Advertising:** How to use Linkedin Professionally, Types of LinkedIn Advertising, LinkedIn New feed Advertising, LinkedIn Message Pitching, Traffic and Leads Generation, Billing and Report. **Email Marketing:** Email Software and Tools, Importing Email Lists, Planning Email Campaign, Email Templates and Designs, Sending HTML Email Campaigns, Web Forms Lead Importing, Integrating Landing Page Forms, Campaign Reports and Insights, Segmentation Strategy, Responder Tracker.	05
6.	**Upcoming Trends in Digital Marketing:** Podcast, OTT Platforms, Mob-Ad, No Click Searches, Google Verified Listing, Voice Search, Visual Search, Online Reviews, Automated and Smart Bidding, Chatbots, Affiliate Marketing.	05
TOTAL		**28**

Text Books :

1. Cory Rabazinsky, "Google-Ad words for Beginners: A Do-It-Yourself Guide to PPC Advertising".
2. Ian Brodie, "Email Persuasion: Captivate and Engage Your Audience, Build Authority and Generate More Sales With Email Marketing".
3. Jan Zimmerman and Deborah, "Social Media Marketing All-In-One for Dummies".
4. Dave Chaffey, Fiona Ellis-Chadwick, Kevin Johnston, Richard Mayer, "Internet Marketing", Pearson Education.

Reference Books:
1. Prof. Seema Gupta, "Digital Marketing", Mcgraw Hill Publications. 2. Judy Strauss, Adel Ansary, Raymond Frost, Prentice Hall, "E- Marketing". 3. Dr. Andy Williams,"WordPress for Beginners 2020: A Visual Step-by-Step Guide to Mastering WordPress". 4. Cecilia Figueroa, "Introduction To Digital Marketing 101", BPB Publications. 5. The Art of Digital Marketing: The Definitive Guide to Creating Strategic, Targeted, and Measurable Online Campaigns by Ian Dodson, Wiley; 1st edition (2016). 6. Digital Marketing For Dummies by Ryan Deiss and Russ Henneberry, For Dummies
E-Resources:
1. Digital Tools Certification- By Google. https://skillshop.exceedlms.com/student/catalog 2. Swayam Certification course on, "Digital Marketing", by Dr. Tejindarpal Singh Panjab University Chandigarh. https://swayam.gov.in/nd2_ugc19_hs26/preview

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Open Elective – II (Entrepreneurship and Innovations)								**Code:** 25ALOE402E	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
02	-	-	02	40	60	-	-	-	100

Prerequisites:

Professional Development, Quality Management Systems.

Course Objectives:

1. To learn the students various aspects of innovation and methods of fostering Innovation
2. To appreciate the importance of embarking on self-employment and has developed the confidence and personal skills for the same.
3. To start a small business enterprise by liaising with different stake holders.
4. To effectively manage small business enterprise.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand the key concepts of innovation.
CO2	Identify and analyze opportunities for innovation.
CO3	Recognize the potential and value of self-employment.
CO4	Develop a viable business plan for a small enterprise.
CO5	Apply financial principles to plan and structure engineering and automation projects effectively
CO6	Apply fundamental principles of management.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Innovation:** Creativity, Invention and innovation, Types of Innovation, Relevance of Technology for Innovation, The Indian innovations and opportunities, Promoting and managing innovation, Innovators and Imitators, Patents, Trademarks, Intellectual Property, Exploring, Executing, Leveraging and renewing innovation, Enhancing Innovation Potential & Formulating strategies for Innovation.	04
2.	**Strategy for Commercializing Innovation:** Innovation Process, Risks and barriers for introducing products and services, selecting a Strategy, setting up the Investment and establishing organization Evaluating the Costs and impact of the Project.	04
3.	**Entrepreneurship:** Definition. Growth of industries in developing countries; role of industries in the national economy; characteristics; demand based and resources based ancillaries and sub-control types. Government policies, stages in starting an industry, types (family business/start-ups etc.), Sources of finance.	04

4.	**Project Identification and Accountancy:** Assessment of viability, formulation, evaluation, financing, field-study and collection of information, preparation of project report, demand analysis, material balance and output methods, **Accountancy:** Preparation of balance sheets and assessment of economic viability, decision making, expected costs, planning and production control, preparation of financial reports, accounts and stores studies.	04
5.	**Project Planning and Control:** The financial functions cost of capital approach in project planning and control. Economic evaluation, risk analysis, capital expenditures, policies and practices in public enterprises. Profit planning and programming, planning cash flow, capital Expenditure and operations. Control of financial flows, control and communication.	06
6.	**Laws:** Laws concerning entrepreneur viz, partnership laws, business ownership, sales and income taxes and workman compensation act. Role of various national and state Agencies which render assistance to small scale industries.	06
TOTAL		**28**

Text Books:

1. Rabindra N. Kanungo, "Entrepreneurship and Innovation", Sage Publications, New Delhi, 1998.
2. Donald F. Kuratko, "Entrepreneurship – Theory, Process and Practice", 9th Edition, Cengage Learning, 2014.
3. Peter F. Drucker, "Innovation and Entrepreneurship", Butterworth-Heinemann.

Reference Books:

1. Robin Lowe and Sue Marriott, "Enterprise: Entrepreneurship and Innovation – Concepts, Contexts and Commercialization", Butterworth-Heinemann.
2. S. S. Khanka, "Entrepreneurial Development", S. Chand & Co. Ltd., Ram Nagar, New Delhi, 2013.
3. Joseph L. Massie, "Essentials of Management", Prentice Hall of India.

E-Resources:

1. https://ocw.mit.edu/collections/entrepreneurship/
2. https://onlinecourses.nptel.ac.in/

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Project Management System – I						**Code:** 25RAMC402			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	
-	02	-	01	-	-	25	-	-	25

Prerequisites:

This course demands attributes like Positive outlook, Teamwork, effective communication, emotional intelligence, computer literacy, people skill, professional attributes, good leader.

Course Objectives:

1. To curate project, its types, classification and characteristics of project
2. To understand various project selection models to select project and check feasibility of it for success.
3. To understand project life cycle analysis, significance of each stage

Course Outcomes: After completion of this course, students will be able to -

CO1	Aware with lifecycle models of project management.
CO2	Know roles and responsibilities of project manager and apply technique of project selection
CO3	Understand project life cycle analysis and implement it to real life projects.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to project management:** Project attributes, types of projects, project classification, characterizers of project, Trends in project managements, SMART project, project, program and portfolio fundamental differences with real world examples, project selection models.	08
2.	**Project Selection Models:** Net present value, weighted scoring model, internal rate of return, analytical hierarchy process, project manager, project manager office, project manager attributes, organization structure of project organization, leadership ethics, management style, leadership competencies.	08
3.	**Project Initiation:** Project life cycle analysis, significance of each stage. Stakeholder types, their role and analysis, commitment assessment matrix, Resolving conflicts, negotiation, human factors in project management, Introduction to Agile project management Project management in real world.	10
	TOTAL	**26**

Text Books:

1. Gary Richard Son, Brad Jackson, "Project Management Theory & Practice" CRC Press.
2. Arun Kanda, "Project Management: A Lifecycle Approach", PHI.
3. John M. Nicholas, Herman Steyn, "Project Management for business engineering and technology", Elsevier.

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Reference Books:
1. Goel, B. B., "Project Management: Principles and Techniques", Deep & Deep Publications Pvt. Ltd. 2. Project Management Institute, "A Guide to the Project Management Body of Knowledge (PMBOK Guide)", Project Management Institute.
E-Resources:
1. Dr. Nimisha Singh, "Introduction to Project Management: Principles & Practices", NPTEL Course - https://onlinecourses.swayam2.ac.in/imb25_mg167/preview 2. Prof. Raghu Nandan Sengupta, "Project Management", NPTEL Course - https://onlinecourses.nptel.ac.in/noc25_mg78/preview 3. Project management for beginners by Ramesh Kumar https://youtu.be/gnkjcRDQkw0?list=PLLy_2iUCG87CBuNhvti0h6W54ZmqrSDMJ

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Problem Solving Techniques – II								**Code:** 25RAAE402	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Problem Solving Techniques-I, Strategic thinking, natural, formal and informal logic, Conceptual clarity, logical reasoning, analytical mind.

Course Objectives:

1. To acquire basic knowledge creative problem solving.
2. To understand the Skills and attitudes requirements for critical thinking.
3. To understand process of creative problem solving and design thinking

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply concepts of critical thinking to complex problems of real world.
CO2	Apply skills and develop attitude of positivity and openness to undertake problem
CO3	Demonstrate ideation tools, diagram and maps for intricate problem solving

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Critical Thinking and Problem Solving:** Knowledge: fundamentals of logics, cognitive biases, advanced problem-solving techniques. Linking Critical Thinking and Cognitive Biases, the art of asking questions, problem framing, problem setting, Classification of methods of Problem Solving, Method for Problem Solving.	08
2.	**Skills and attitudes requirements for critical thinking:** Skills: identify own cognitive biases, identify biases in other, ability to apply a structured method to solve problems. Attitudes: metacognition, positivity with respect to problems Use Scenarios, Solving Contradictions, Combination, Crossover, brainstorming 3-6-5, 9 quadrants, Functional Brainstorming, TRIZ, The power of critical thinking: Effective reasoning about ordinary and extraordinary claims.	08
3.	**Design Thinking:** The Basis for Design Thinking, The Design Thinking Team, Design Thinking Workshops and Meetings, Listening and Empathizing Techniques Design Thinking Frameworks, Ideation tools, Use of Diagrams and Maps in Design Thinking – Empathy map. Affinity diagram, mind map, journey map Brief introduction of storytelling.	10
	TOTAL	**26**

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Text Books:
1. B. Mahadevan, "Operations Management: Theory and Practice", Pearson Education India. 2. L.M. Prasad, "Principles and Practices of Management", Sultan Chand & Sons. 3. Goudar, Amitkumar, "The Secrets of Design Thinking Mindset: More Tools and Techniques to Enhance Your Design Thinking Skill", Notion Press. 4. Agarwal, Anuja, "Design Thinking: A Framework for Applying Design Thinking in Problem Solving", 1st Edition, BPB Publications.
Reference Books:
1. Henderson, William, "Master Critical Thinking, Creative, Logic & Problem-Solving Skills", Peak Publish LLC. 2. Sharma, Narender, "Handbook of 7 QC Tools", Shakehand with Life.
E-Resources:
1. Coursera: "Effective Problem-Solving and Decision-Making" - https://www.coursera.org/learn/problem-solving 2. Design thinking by NPTEL Link - nptel.ac.in/courses/110106124

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Python for Robotics						**Code:** 25RAVS406			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	-	-	25	25

Prerequisites:

Basic knowledge of programming (any language), logic development, and electronics.

Course Objectives:

1. To introduce students to programming fundamentals using Python.
2. To develop logical thinking and coding skills applicable in robotics.
3. To provide hands-on experience in writing Python scripts for basic I/O and data handling.
4. To build a foundation for future robotic applications using Python.

Course Outcomes: After completion of this course, students will be able to -

CO1	Understand basic syntax, variables, and data types in Python.
CO2	Write Python programs using control structures and loops.
CO3	Use lists, strings, and functions to organize code efficiently.
CO4	Read input from the user and display output in formatted ways.
CO5	Understand and implement file handling and simple modules.
CO6	Develop basic sensor simulation and logic circuits using Python logic.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	**Introduction to Python:** History of Python, installation, Python IDE, writing and running a Python program for basic robotic tasks, syntax, indentation in robot control code.	04
2.	**Variables and Data Types:** Integers, floats, strings, Booleans used in robot sensors and actuators, type conversion, input/output functions for user and sensor interaction.	04
3.	**Operators and Control Structures:** Arithmetic, comparison, logical operators applied in robotic decisions, if-else, nested conditions for task flow in autonomous robots.	04
4.	**Loops and Functions:** for, while, break/continue for repeated robotic actions, defining and calling functions for robot behaviors, parameters, return values for modular robot control.	04
5.	**Data Structures:** Lists, tuples, dictionaries, sets to manage sensor data and commands, indexing, slicing, basic operations on robotic data collections.	06

6.	**Introduction to Robotics with Python:** Simulating sensor logic, printing actuator patterns, mini I/O robotics projects using logic, basic serial input/output for hardware interfacing.	06
TOTAL		**28**

List of Experiments:

1. Print "Hello, World!" and take user input
2. Use variables and perform arithmetic operations
3. Write a program using if-else to check threshold value
4. Use for and while loops to print number patterns
5. Create and manipulate a list of values
6. Define a function to calculate average of numbers
7. Use dictionary to store and access key-value pairs
8. File handling – read/write a simple text file
9. Use time delays with time. sleep() and print statements
10. Use basic logic with conditionals for directional decisions

Text Books:

1. Michael Driscoll, "Python 101", Mike Driscoll Publishing.
2. Charles Severance, "Python for Everybody", Open Access.

Reference Books:

1. Eric Matthes, "Python Crash Course", No Starch Press.
2. John Zelle, "Python Programming: An Introduction to Computer Science", Franklin.
3. Lentin Joseph, "Learning Robotics Using Python", Packt Publishing.

E-Resources:

E-book versions are available

1. NPTEL – The Joy of Computing Using Python
   https://nptel.ac.in/courses/106106182
2. SWAYAM – Python Programming Courses
   https://onlinecourses.swayam2.ac.in/e-learning/preview/cec23_cs14
3. Data Science: Empowering Business Strategy
   https://ieeexplore.ieee.org/document/9105744
4. Virtual Labs (MoE, IITs) – Python Programming Lab
   https://python-iitk.vlabs.ac.in/
5. Harvard University- CS50's Introduction to Programming with Python
   https://cs50.harvard.edu/python?utm_source=chatgpt.com

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Liberal Learning - IV

DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Guitar)								**Code:** 25RACC406A	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Guitar musical instrument.

Course Objectives:

1. To develop advanced technical proficiency, musical interpretation, and performance skills through complex repertoire.
2. To enhance creativity, improvisation, composition, and theoretical understanding across multiple musical genres.
3. To strengthen ensemble leadership, stage performance, and professional musicianship for advanced musical pursuits.

Course Outcomes: After completion of this course, students will be able to -

CO1	Perform advanced guitar repertoire with technical accuracy, musical expression, and stylistic interpretation.
CO2	Apply advanced harmony, rhythm, improvisation, composition, and performance techniques across different musical genres.
CO3	Demonstrate ensemble leadership, collaboration, stage etiquette, and professional musicianship.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of Semester III Concepts	02
2.	Advanced Chord Voicings & Inversions	02
3.	Modal Scales & Advanced Scale Applications	02
4.	Improvisation over Chord Progressions	02
5.	Advanced Fingerstyle & Hybrid Picking	02
6.	Guitar Solo Techniques – Bends, Vibrato, Legato	02
7.	Song Arrangement & Musical Interpretation	02
8.	Introduction to Composition & Melody Writing	02
9.	Ensemble Rehearsal & Musical Communication	02
10.	Genre-based Performance (Jazz, Rock, Blues, Contemporary)	02
11.	Stage Performance Techniques & Performance Psychology	02
12.	Mock Recital & Individual Feedback	02
13.	Final Rehearsal & Performance Preparation	02
TOTAL		**26**

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Text Books:

1. Hal Leonard Corporation, "Hal Leonard Guitar Method – Complete Edition", Hal Leonard Publications.
2. Mel Bay, "Modern Guitar Method – Grade 1, 2 & 3", Mel Bay Publications.
3. Leavitt, W., "A Modern Method for Guitar (Books 1–3)", Berklee Press.
4. Stetina, T., "Fretboard Mastery", Hal Leonard Publications.
5. Kolb, T., "Music Theory for Guitarists", Hal Leonard Publications.

Reference Books:

1. Chapman, R., "The Complete Guitar Manual", DK Publishing.
2. Latarski, D., "Practical Theory for Guitar", Alfred Music.
3. Denyer, R., "The Guitar Handbook", Knopf Publishing.
4. Buckingham, B., "Scales and Modes for Guitar", Hal Leonard Publications.

E-Resources:

1. Berklee Online – Guitar lessons, music theory, ear training, and performance resources. https://online.berklee.edu
2. JustinGuitar – Structured guitar lessons from beginner to advanced. https://www.justinguitar.com
3. Fender Play – Interactive lessons on chords, scales, techniques, and songs. https://www.fender.com/play
4. TrueFire – Professional online guitar courses covering multiple genres and techniques. https://truefire.com
5. Ultimate Guitar – Tabs, chord charts, scales, and community resources. https://www.ultimate-guitar.com
6. MuseScore – Free music notation software and sheet music library. https://musescore.org
7. MusicTheory.net – Interactive music theory lessons and exercises. https://www.musictheory.net
8. Yamaha Music India – Educational resources on guitar fundamentals and musicianship. https://in.yamaha.com

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Singing)								**Code:** 25RACC406B	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music in singing.

Course Objectives:

1. To develop voice modulation, singing, and expression techniques across different musical genres.
2. To familiarize students with microphone handling, studio setup, microphone placement, and recording practices.
3. To enhance students' recording and stage performance skills through practical application of raga, tala, rasa, and presentation techniques.

Course Outcomes: After completion of this course, students will be able to -

CO1	Apply voice modulation, pitch control, and singing techniques in various styles.
CO2	Perform Khayal, Semi-Classical, and Folk compositions with musical expression.
CO3	Demonstrate microphone handling, recording skills, and stage presentation.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Voice range development and voice modulation, Pitch control and tonal accuracy	04
2.	Voice culture for studio singing	04
3.	Singing techniques in different genres: Light Music, Film Songs, Ghazals, Lavani etc., Expression according to song style	04
4.	Vilambit Khayal, Drut Khayal	04
5.	Semi-Classical Music, Folk Music	02
6.	Performance practice, Stage presentation skills	02
7.	Knowledge of Raga and Tala, Rasa and Musical Expression	02
8.	Studio setup, Microphone handling techniques, Microphone placement, Recording techniques, Recording practice	04
	TOTAL	**26**

Text Books:

1. Bhatkhande, V. N., "Kramik Pustak Malika (Vol. III & IV)", Hindustani Music Publications.
2. Paluskar, V. D., "Sangeet Bal Prakash", Gandharva Mahavidyalaya Mandal.

Reference Books:
1. Bhatkhande, V. N., "Hindustani Sangeet Paddhati (Vol. I–IV)", Sangeet Karyalaya. 2. Ranade, A. D., "Hindustani Music: Tradition in Transition", Promilla & Co. Publishers. 3. Ratanjankar, S. N., "Abhinav Geet Manjari", Sangeet Karyalaya.
E-Resources:
1. Sangeet Natak Akademi 2. All India Radio (Akashvani) 3. SwarGanga Music Foundation 4. YouTube – Sangeet Natak Akademi Channel 5. Digital Tanpura and Tabla Applications (e.g., iTanpura, Riyaz, NaadSadhana)

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Cinematography)								**Code:** 25RACC406C	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

A basic understanding of film theory, Camera operation, Lighting techniques and visual storytelling is essential for cinematography.

Course Objectives:

1. To develop proficiency in camera operation, exposure settings, and photographic composition.
2. To apply lighting techniques and visual storytelling principles across different photography genres.
3. To develop basic image editing and post-processing skills using appropriate software.
4. To enhance creative, technical, and professional skills for effective photography practice.

Course Outcomes: After completion of this course, students will be able to -

CO1	Operate cameras confidently and use various camera settings effectively.
CO2	Apply exposure principles by controlling aperture, shutter speed, and ISO to capture quality images.
CO3	Compose visually appealing photographs using principles of composition and design.
CO4	Utilize natural and artificial lighting techniques to enhance photographic results.
CO5	Capture photographs in different genres such as portrait, landscape, product, event, and wildlife photography.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision Session Of Sem III	2
2.	Storyboarding and planning	2
3.	Short film Screening	2
4.	Short Film Project (Camera-Phone)	2
5.	Short Film Project	2
6.	Short Film Project	2
7.	Short Film Project	2
8.	Short Film Project	2
9.	Short Film Project	2
10.	Short Film Project Submission	2
11.	Introduction Video Editing	2
12.	Basic Knowledge of Editing Tools	2
13.	Basics Timeline, Color Correction, Transition, Effects	2
TOTAL		**26**

Text Books:
1. Peterson, B., "Understanding Exposure – Theory + Fundamentals", Amphoto Books. 2. Kelby, S., "The Digital Photography Book – Practical + Shooting", Rocky Nook.
Reference Books:
1. Langford, M., "Langford's Basic Photography – Technical Concepts", Focal Press. 2. Freeman, M., "The Photographer's Eye – Composition, Visual Balance, Framing, Perspective", Ilex Press.
E-Resources:
1. https://youtu.be/V7z7BAZdt2M?si=to4yQ46zEKRbxKOm 2. https://youtu.be/WXdAX0No2hM?si=GZu_mJsmyJ7NGnAU

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Dance)								**Code:** 25RACC406D	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Good stamina, flexibility and familiarity with simple rhythmic patterns and beats.

Course Objectives:

1. To develop advanced dance techniques with precision, coordination, balance, flexibility, and rhythmic control.
2. To enhance expressive skills, musicality, stage presence, and overall performance quality.
3. To develop creativity and choreography skills through individual and group dance compositions.
4. To integrate technique, rhythm, expression, synchronization, and stagecraft in complete performances.
5. To develop leadership, teamwork, discipline, confidence, and professional performance skills through rehearsals, competitions, and cultural events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate advanced dance techniques with precision, coordination, flexibility, balance, and rhythmic control.
CO2	Apply musicality, expression, synchronization, creativity, and stage presence in individual and group performances.
CO3	Create and present dance compositions using advanced choreography, formations, transitions, and stagecraft.
CO4	Plan, rehearse, and perform polished dance presentations for cultural events, competitions, and advanced training.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	Revision of prior semester & Warm-up	2
2.	Introduction formatted story telling through dance	2
3.	Learning the First Half of the Composition ,	2
4.	Completion of Composition with Rhythm and introduction to live music dancing format	2
5.	Theme-Based Choreography – Planning and Concept Development	2
6.	Production introduction and choreography completion	2
7.	Lights and stage formative knowledge	2
	TOTAL	**26**

Text Books:
1. Bharata Muni, "Natya Shastra", translated by Manomohan Ghosh, Asiatic Society, Kolkata. 2. Nandikeshvara, "Abhinaya Darpana", translated by Manomohan Ghosh. 3. Balasaraswati, T., "Dance", Madras Music Academy. 4. Krishna Iyer, E., "Dance", Ganesh & Co., Chennai.
Reference Books:
1. Kothari, Sunil, "Dance", Marg Publications, Mumbai. 2. Vatsyayan, Kapila, "Dance: Indian Dance in Literature and the Arts", Sangeet Natak Akademi. 3. Payne, Helen, "Creative Dance and Movement in Groupwork", Routledge, 2021.
E-Resources:
1. https://youtu.be/VTrGVHvWfPA?si=AvKTenB7bpx302R6 2. https://youtu.be/pG0NmQDKspc?si=AEfhbRAEs9OjNErp 3. https://youtu.be/eg-3ybiL6UI?si=AOj0NuGXDupxD2Mt

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)							**Semester:** IV		
Course: Liberal Learning – IV (Synthesizer/Keyboard)							**Code:** 25RACC204E		
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Basic knowledge of Indian classical music and Keyboard musical instrument.

Course Objectives:

1. To strengthen understanding of fundamental keyboard concepts and techniques.
2. To develop proficiency in major and minor scales and arpeggios through practical exercises.
3. To enhance accompaniment, improvisation, and jamming skills through practical performance.
4. To develop listening skills, musical creativity, and ensemble performance techniques.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate improved technical proficiency through advanced practice of Major and Minor Scales.
CO2	Perform musical pieces based on Minor Scales with proper fingering, expression and dynamics.
CO3	Apply arpeggio patterns effectively in chord progressions and keyboard performance.
CO4	Demonstrate accompaniment, improvisation and jamming skills in solo and group performances.
CO5	Develop listening ability, rhythmic accuracy and musical confidence through ear training and ensemble practice.

Course Contents:

Unit	**Description**	**Duration (Hrs.)**
1.	Revision of all Major Scales	2
2.	Revision of all Minor Scales (Natural, Harmonic & Melodic)	2
3.	Revision of Major and Minor Chords,	2
4.	Revision of Chord Progression, Family chords, Chords Inversion	2
5.	Playing Simple Songs with Indian Notation	2
6.	Introduction to Staff Notation	2
7.	Understanding the Difference between Indian and Western Staff	2
8.	Reading and Playing Simple Melodies from Staff Notation	2
9.	Playing Songs using Both Indian and Staff Notation	2
10.	Fundamentals of Keyboard Accompaniment	2
11.	Accompaniment using Major and Minor Chords	2
12.	Accompaniment with Scales and Simple Songs	2
13.	Group Performance	2
	TOTAL	**26**

Text Books:
1. Aaron, M., "Michael Aaron Piano Course – Grade 2", Alfred Music. 2. Thompson, J., "John Thompson's Modern Course for the Piano – Second Grade", Willis Music. 3. Hanon, C. L., "The Virtuoso Pianist in Sixty Exercises", G. Schirmer. 4. Agay, D., "Learning to Play Piano – Book 2", Yorktown Press.
Reference Books:
1. Thompson, J., "Modern Course for the Piano", Willis Music. 2. Aaron, M., "Piano Course", Alfred Music. 3. Harrison, M., "Contemporary Music Theory", Hal Leonard. 4. Hanon, C. L., "The Virtuoso Pianist", G. Schirmer. 5. ABRSM, "Music Theory in Practice (Grades 1–5)", Associated Board of the Royal Schools of Music.
E-Resources:
1. https://youtu.be/2mPS-2guHVo?si=8X_4KKezIdrMejLH 2. https://youtu.be/tEtukfFv3Wk?si=2iJ8wdD0dfjWauPb

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Basketball)						**Code:** 25RACC406F			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop fundamental basketball skills, physical fitness, teamwork, and understanding of rules and strategies to enable effective participation and performance in the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate fundamental basketball skills including passing, dribbling, shooting, and rebounding.
CO2	Apply proper footwork, body control, and individual defensive techniques during play.
CO3	Integrate fundamental skills effectively through drills, small-sided games, and practice matches.
CO4	Demonstrate teamwork, coordination, confidence, and consistency in basketball performance.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Complete Skill Revision:** Review all basketball fundamentals. Recall and perform all basic skills.	2
2.	**Passing & Receiving Practice:** Improve passing speed and accuracy. Demonstrate efficient passing skills.	2
3.	**Dribbling:** Enhance control and confidence. Maintain effective dribbling during movement.	2
4.	**Shooting:** Continue improving shooting technique. Achieve better shooting consistency.	2
5.	**Rebounding:** Reinforce rebounding fundamentals. Secure rebounds confidently.	2
6.	**Individual Defense:** Improve defensive positioning. Apply correct defensive techniques.	2
7.	**Assessment – VII**	2
8.	**Body Technique and Footwork:** Reinforce movement and balance. Demonstrate efficient basketball footwork.	2
9.	**Skill Integration:** Combine all fundamental skills. Execute basketball movements smoothly.	2
10.	**Partner Skill:** Develop teamwork through drills. Improve coordination with teammates.	2

11.	**Small Sided Games:** Apply skills in simple match situations. Use basketball fundamentals during gameplay.	2
12.	**Practice Match:** Reinforce practical learning. Participate confidently in basketball games.	2
13.	**Assessment - VIII**	2
	TOTAL	**26**

Text Books:

1. FIBA, "Official Basketball Rules", International Basketball Federation (FIBA)
2. Dr. James Naismith, "Basketball: Its Origin & Development"
3. John R. Wooden, "Practical Modern Basketball", Allyn & Bacon

Reference Books:

1. James Naismith – Basketball: Its Origin and Development – University of Nebraska Press.
2. Jerry V. Krause & Don Meyer – Basketball Skills & Drills – Human Kinetics

E-Resources:

1. Rules of Basketball : How to Play Basketball : Basketball Rules for Beginners
2. How To Dribble A Basketball For Beginners! Basketball Basics for Kids Basketball Training
3. How To Shoot A Basketball For Beginners! Basketball Basics [SECRETS]
4. Basketball: Rebounding

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** II			
Course: Liberal Learning – II (Cricket)						**Code:** 25RACC204G			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop basic cricket skills. Fitness, teamwork, and knowledge of rules and strategies for effective game performance.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate basic batting, bowling, and fielding skills with consistency.
CO2	Apply learned cricket skills, coordination, and decision-making during match situations.
CO3	Demonstrate basic umpiring knowledge, fair play, teamwork, and sportsmanship.
CO4	Demonstrate overall cricket proficiency through practice and competitive matches.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Revision of Batting Skills:** Strengthen all basic batting techniques.	2
2.	**Revision of Bowling:** Improve consistency and control in bowling.	2
3.	**Revision of Fielding Skills:** Enhance catching, throwing, and ground fielding.	2
4.	**Combined Skill Practice:** Practice batting, bowling, and fielding together.	2
5.	**Net Practice:** Improve performance through focused practice.	2
6.	**Team Coordination:** Develop communication during play.	2
7.	**Assessment - VII**	2
8.	**Match Awareness Practice Match I:** Understand basic match situations / Apply all learned skills in a game.	2
9.	**Practice Match II:** Improve decision-making during play.	2
10.	**Practice Match III:** Build confidence through match experience.	2
11.	**Basic Umpiring:** Learn simple umpiring signals and decisions.	2
12.	**Fair Play & Sportsmanship:** Understand discipline and ethics in cricket.	2
13.	**Assessment - VIII**	2
TOTAL		**26**

Text Books:
1. Sridhar, R., "Coaching Beyond", Rupa Publications India.
Reference Books:
1. Eastaway, R., "Cricket Explained: From Grubbers to Googlies", St. Martin's Griffin.
E-Resources:
1. How to Play Cricket 2. Cricket rules explained in 2 minutes 3. Every Cricket Shot Explained in 21 Minutes

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Rifle and Pistol Shooting)						**Code:** 25RACC406H			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To develop safe shooting skills, accuracy, concentration, and proper shooting techniques in students.
2. To build discipline, confidence and prepare shooters for competitive events.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain safe rifle handling, range discipline, equipment, and match procedures.
CO2	Demonstrate proper shooting techniques, coordination, and posture.
CO3	Apply mental focus and scientific principles to improve shooting performance.
CO4	Demonstrate discipline, sportsmanship, and overall shooting proficiency.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Shot calling:** Shot calling is the ability to mentally identify the exact location of the shot.	2
2.	**Maintain training diary:** To maintain notes given by coach	2
3.	**Pressure handling:** To handle pressure during match, shooters get tensed during match due to crowd or pressure about the performance	2
4.	**Full qualification matches:** Qualifying test match	2
5.	**Final match:** Final match between the qualified shooters	2
6.	**Dry firing test:** To do the whole process of firing the shot but the gun is not loaded	2
7.	**Assessment –VII**	2
8.	**Advanced Accuracy Drills:** It is a structured training exercise designed to improve precision, consistency, shot execution and mental control.	2
9.	**Mock Competition I:** It is a simulated shooting match conducted under actual competition conditions –match no.- **1**	2
10.	**Mock Competition II:** It is a simulated shooting match conducted under actual competition conditions –match no.- **2**	2
11.	**Equipment Inspection and Adjustment:** Learn to adjust the weapon according to the shooter	2
12.	**Ethics and sportsmanship:** It refers to the moral principles ,values, and respectful behavior that guide shooters during training and competition	2
13.	**Assessment – VIII**	2
	TOTAL	**26**

DEPARTMENT OF ROBOTICS AND AUTOMATION

Text Books:

1. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
2. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America
3. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

Reference Books:

1. National Rifle Association (NRA), "The Fundamentals of Rifle Marksmanship", National Rifle Association of America
2. International Shooting Sport Federation (ISSF), "ISSF Official Statutes, Rules and Regulations", International Shooting Sport Federation (ISSF)
3. National Rifle Association (NRA), "The NRA Guide to the Basics of Pistol Shooting", National Rifle Association of America
4. National Rifle Association (NRA), "The NRA Guide to the Basics of Rifle Shooting", National Rifle Association of America

E-Resources:

1. Introduction to Exercise Physiology & Sports Performance, IIT Madras, https://nptel.ac.in/courses/109106406
2. Open Sight Air Rifle Shooting Sports For Beginners. @TheGunzoneNetwork - YouTube
3. Basics of the Standing Position | Sauer Academy
4. The Ideal Air Rifle Shooter with Abhinav Bindra [IND]

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)						**Semester:** IV			
Course: Liberal Learning – IV (Volleyball)						**Code:** 25RACC406I			
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To equip participants with the essential skills and knowledge of volleyball, enabling them to perform fundamental techniques, understand basic rules, and participate in basic gameplay scenarios confidently.

Course Outcomes: After completion of this course, students will be able to -

CO1	Explain the official rules, referee signals, and scoring procedures of volleyball.
CO2	Demonstrate advanced volleyball skills, fitness components, and position-specific techniques.
CO3	Apply offensive, defensive, and tactical strategies effectively during competitive play.
CO4	Demonstrate proficiency in officiating, teamwork, sportsmanship, and overall match performance.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Official Volleyball Rules:** History and development of volleyball rules, Court dimensions and equipment specifications, Team composition and player positions, Rotation and substitution rules, Scoring system (Rally Point System), Faults, violations, and penalties, Service order and match regulations.	02
2.	**Referee Signals:** Duties of the first and second referee, Official hand signals for all game situations, Line judge signals, Communication between officials, Practical demonstration of referee signals.	02
3.	**Score Sheet And Match Procedures:** Components of the official score sheet, Recording player line-ups and substitutions, Recording time-outs, sanctions, and scores, Match protocol before, during, and after play, Practical score sheet filling	02
4.	**Physical Conditioning:** Volleyball-specific warm-up exercises, Strength development for upper and lower body, Core stability exercises, Endurance training, Cool-down and recovery methods.	02
5.	**Speed And Agility And Plyometric:** Sprint drills , Agility ladder exercises, Cone drills , Jump training (plyometrics) , Explosive movement drills for volleyball	02
6.	**Flexibility And Injury Prevention:** Dynamic and static stretching, Mobility exercises, Common volleyball injuries, Injury prevention techniques, Recovery and rehabilitation basics	02

7.	**Assessment - VII**	02
8.	**Position-Specific Training:** Setter responsibilities and drills, Outside hitter techniques, Middle blocker skills, Opposite hitter training, Libero defensive techniques, Position-based game practice.	02
9.	**Complex Offensive System:5**–1 offensive system, 6–2 offensive system, Quick attack combinations, Setter-hitter coordination, Transition offense, Team offensive strategies.	02
10.	**Complex Defensive System:** Block defence system, Perimeter defense, Rotation defense, Backcourt positioning, Defensive communication, Transition from defense to attack.	02
11.	**Tournament Practice:** League and knockout match formats, Tournament scheduling, Team strategy under competition conditions, Match officiating practice, Sportsmanship and fair play.	02
12.	**Comprehensive Skill Revision:** Revision of all technical skills, Tactical system review, Fitness drills, Match-based practice, Error correction and performance improvement	02
13.	**Assessment - VIII**	02
TOTAL		**26**

Text Books:

1. Fédération Internationale de Volleyball (FIVB), "Official Volleyball Rules", FIVB Publications
2. Bonnie Kenny & Cindy Gregory, "Volleyball: Steps to Success", Human Kinetics
3. Anita Bean, "The Complete Guide to Sports Nutrition", Bloomsbury Sport
4. Ian Jeffreys, "The Warm-Up", Human Kinetics

Reference Books:

1. Pete Waite, "Aggressive Volleyball", Human Kinetics
2. Bob Bertucci, "Volleyball Drill Book", Human Kinetics

E-Resources:

1. Volleyball Rules : How to Play Volleyball : The Rules of Volleyball EXPLAINED!
2. 6 Basic Skills in Volleyball - YouTube
3. Everything You Need to Know About the Game of Volleyball - YouTube

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics & Automation Engineering)								**Semester:** IV	
Course: Liberal Learning – IV (Football)								**Code:** 25RACC406J	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	02	-	01	-	-	25	-	-	25

Prerequisites:

Proper health, Basic knowledge of rules of the game.

Course Objectives:

1. To enhance football players' technical skills, tactical understanding, physical fitness, teamwork, and sportsmanship, fostering a comprehensive understanding and appreciation of the game.

Course Outcomes: After completion of this course, students will be able to -

CO1	Demonstrate advanced football skills, position-specific techniques, and physical conditioning.
CO2	Apply leadership, coaching, refereeing, and talent identification skills in football.
CO3	Analyze match statistics, player performance, and team effectiveness using appropriate methods.
CO4	Demonstrate teamwork, fair play, ethics, and overall football proficiency in competitive matches.

Course Contents:

Sr. No.	**Description**	**Duration (Hrs.)**
1.	**Advanced Technical Drills:** Develop advanced football techniques through challenging drills that improve skill execution, speed, accuracy, and game adaptability.	2
2.	**Position-Specific Training:** Understand and apply position-specific skills, roles, and responsibilities to enhance individual performance within the team structure.	2
3.	**Leadership & Captaincy:** Develop leadership qualities, communication skills, and decision-making abilities to effectively guide and motivate teammates.	2
4.	**Football Coaching Methods:** Understand and apply effective coaching methods, session planning, and teaching approaches to improve player development.	2
5.	**Talent Identification:** Understand the principles of talent identification by evaluating technical, physical, tactical, and psychological attributes of players.	2
6.	**Strength & Conditioning:** Develop football-specific strength, endurance, speed, agility, and conditioning to improve athletic performance and reduce injury risk.	2
7.	**Assessment-VII**	2
8.	**Refereeing & Match Officiating:** Understand the laws of the game and develop basic refereeing skills for fair and effective match officiating.	2
9.	**Match Statistics & Performance Analysis:** Analyze match statistics and performance data to evaluate player contributions, team effectiveness, and areas for improvement.	2

10.	**Fair Play & Professional Ethics:** Understand the importance of fair play, respect, discipline, teamwork, and ethical behavior in football.	2
11.	**Tournament Practical:** Apply technical, tactical, physical, and teamwork skills in a competitive tournament environment.	2
12.	**Final Competitive Match:** Demonstrate overall football development by applying skills, tactics, teamwork, and sportsmanship in a competitive match setting.	2
13.	**Assessment-VIII**	2
TOTAL		**26**

Text Books:

1. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA.
2. International Football Association Board (IFAB), "Laws of the Game", IFAB.

Reference Books:

1. Hughes, C., "The Winning Formula in Soccer", Meyer & Meyer Sport.
2. Fédération Internationale de Football Association (FIFA), "Laws of the Game", FIFA.
3. International Football Association Board (IFAB), "Laws of the Game", IFAB

E-Resources:

1. Beginner's guide to football | Football for dummies
2. Every position in soccer explained
3. Rules Of Soccer : How to play Soccer : Soccer Rules for Beginners

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DEPARTMENT OF ROBOTICS AND AUTOMATION

Program: B. Tech. (Robotics and Automation)								**Semester:** IV	
Course: Internship – II								**Code:** 25RAIN402	
Teaching Scheme (Hrs./Week)				**Evaluation Scheme (Marks)**					
Lecture	**Practical**	**Tutorial**	**Credit**	**CIE**	**ETE**	**TW**	**OR**	**PR**	**Total**
-	-	-	02	-	-	25	-	-	25

Preamble:

Internships serve as vital educational and career development experiences, offering practical exposure in a specific field. Employers seek individuals who possess the necessary skills and an understanding of industry environments, practices, and cultures. This internship is designed as a structured, short-term, supervised training program, often centered on specific tasks or projects with clear timelines. The primary goal is to immerse technical students in an industrial setting, providing experiences that cannot be replicated in the classroom. This exposure aims to develop competent professionals who understand the social, economic, and administrative factors influencing the operations of industrial organizations.

Course Objectives:

1. Exposure to students to the industrial environment, which cannot be provided in the classroom and hence creating deployable professionals for the industry.
2. Learn to implement the technical knowledge in real industrial situations.

Course Outcomes: After completion of this course, students will be able to -

CO1	Gain exposure to industry practices and understand how academic concepts are applied in professional settings.
CO2	Develop and demonstrate effective communication and teamwork skills within a work environment.
CO3	Improve your problem-solving and time management skills by working in real-world industry settings.

Internship Requirements

1. **Internship Duration:** It is mandatory for all students to undergo an internship after every semester during vacations for the duration of 3 to 5 weeks. Internships completed during this period will be considered for the assessment of Term Work (TW).
2. **Internship Opportunities:** Students can explore various opportunities for internships at:
    a. Industries
    b. Research labs or organizations
    c. Collegiate clubs
    d. In-house research projects
    e. Online internships
3. **Support and Assistance:** Students can seek assistance for securing internships from:
    a. The Training and Placement cell, along with departmental coordinators
    b. Department or institute faculty members
    c. Personal contacts
    d. Directly connecting with industries or organizations
4. **Request Letter:** Once an industry, research organization, or collegiate club is identified,

Students must obtain a request letter from the concerned department or placement office. This letter, in the standard format must be duly signed by the authority, should be addressed to the HR manager or relevant authority.

5. **Confirmation Letter:** Students must submit the confirmation letter from the industry, research organization, or collegiate club to the Internship Coordinator and the Head of Department (HOD) office.
6. **Joining Report:** Upon commencing the internship, students must submit the joining report, joining letter, or a copy of the confirmation email to the Internship Coordinator and the HOD office.
7. **Faculty Mentor:** A faculty member will be assigned as a mentor to a group of students. The mentor will be responsible for monitoring, evaluating, and assessing student internship activities. The faculty mentor is also required to visit the internship location and submit formal feedback to the Internship Coordinator.
8. **Faculty Visits:** Faculty members are advised to visit the internship site once or twice during the internship period to monitor progress.
9. **Progress Report:** Students must submit progress report fortnightly to their faculty guide and the final internship report to the Internship Coordinator and department office.
10. **Evaluation Report:** After the completion of the internship, the mentor, along with the assessment panel members, should submit the evaluation report of the students to the department office and the Internship Coordinator.
11. **Internship Certificate:** Students must receive the Internship Certificate from the industry and submit it to the Internship Coordinator and department office.
12. **Presentation and Assessment:** Students are required to give a presentation on their internship work as part of the term work. The internship diary and report will also be verified and assessed.

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