B. TECH (AUTOMATION & ROBOTICS)

STUDY SCHEME & SYLLABUS

BATCH (2023 ONWARDS) I.K.

Gujral PTU, KAPURTHALA

Semester Third (Contract Hours: 28 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR301-18	Industrial Automation and Robotics	4	0	0	4	40	60	100	4
BTAR302-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAM 302-23	Mathematics –III (Probability & Statistics)	4	1	0	4	40	60	100	4
BTAR304-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAR305-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAR306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAR307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAR308-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**290**	**360**	**650**	**23**

Semester Fourth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Mark s	Credit points
BTAR401-18	Design of Machine Elements	4	1	0	5	40	60	100	5
BTAR402-18	Manufacturing Technology	4	0	0	4	40	60	100	4
BTAR403-18	Hydraulic and Pneumatics	4	0	0	4	40	60	100	4
BTAR404-18	Basic Electronics Engineering	3	0	0	3	40	60	100	3
BTAR405-18	Industrial Safety	3	0	0	3	40	60	100	3
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non Credit
BTAR406-18	Manufacturing Technology Lab	0	0	2	2	30	20	50	1
BTAR407-18	Hydraulic and Pneumatics Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**360**	**340**	**700**	**21**

Semester Fifth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR501-18	Electronics Devices and Circuits	4	0	0	4	40	60	100	4
BTAR502-18	Computer Aided Design and Manufacturing	4	0	0	4	40	60	100	4
BTAR503-18	Robotics Engineering and Applications	4	0	0	4	40	60	100	4
BTAR504-18	Digital Electronics	3	0	0	3	40	60	100	3
HSMC101-18 / HSMC102-18*	Humanities -I	3	0	0	3	40	60	100	3
BTAR505-18	Electronics Devices and Circuits Lab	0	0	2	2	30	20	50	1
BTAR506-18	Computer Aided Design and Manufacturing Lab	0	0	2	2	30	20	50	1
BTAR507-18	Digital Electronics Lab	0	0	2	2	30	20	50	1
BTAR508-18	German/Japanese/ French Language Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**320**	**380**	**700**	**22**

Semester Sixth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR601-18	Power Electronics and Drives	3	1	0	4	40	60	100	4
BTAR602-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAR603-18	Electronic Measurement and Instrumentation	4	0	0	4	40	60	100	4
BTAR604-18	Microprocessors and Microcontrollers	4	0	0	4	40	60	100	4
BTAR605-18	Introduction to Industrial Management	3	0	0	3	40	60	100	3
BTAR606-18	Microprocessors and Microcontrollers Lab	0	0	2	2	30	20	50	1
BTAR607-18	Electronic Measurement and Instrumentation Lab	0	0	2	2	30	20	50	1
BTAR608-18	Project -I (Project/Internship)	0	0	4	4 / 90hrs	30	20	50	2
BMPD601-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**29**	**290**	**360**	**650**	**23**

The project work will be carried out in parts as minor project in 6th semester and major project in 7/8th semester. The literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the project shall be decided in 6th semester. The same project problem is to be extended in the major project in semester. The minor project may be carried out by a group of students 2 to 4.

Semester Seventh /Eighth

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR701-18	Control Systems	4	0	0	4	40	60	100	4
BTAR 702-18	Programming Industrial Automation systems	4	0	0	4	40	60	100	4
Elective -I		3	1	0	4	40	60	100	4
Elective-II		3	0	0	3	40	60	100	3
BTAR703-18	Advanced Robotics	3	0	0	3	40	60	100	3
BTAR704-18	Advanced Robotics	0	0	2	2	30	20	50	1
BTAR705-18	Major Project	0	0	8	8	30	20	50	4
BMPD701-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**260**	**340**	**600**	**23**

List of Subjects (Elective- I)

S. No	Subject Code	Subject Name	Credits
1	**BTAR706-18**	Communication System	4
2	**BTAR707-18**	Sensors & Signal Processing	4
3	**BTAR708-18**	Micro-controller and PLC	4
4	**BTAR709-18**	Mechanical Vibration	4
5.	**BTAR710-18**	Electromechanically Energy Conversion and DC Machines	4

List of Subjects (Elective- II)

S. No	Subject Code	Subject Name	Credits
1	**BTAR711-18**	Linear Integrated Circuits	3
2	**BTAR712-18**	Human Resources Management	3
3	**BTAR713-18**	Total Quality Management	3
4.	**BTAR714-18**	Non-Conventional Energy Resources	3

Semester Seventh /Eighth

Code	Course Title	Evaluation Internal (Maximum Marks)		External (Maximum Marks)	Total Marks	Credit Points
		Institute	Industry			
BTAR-801-18	**Software**	100	50	100	250	8
	Industrial	100	50	100	250	8
	Total	200	100	200	500	16

DETAILED SYLLABUS

Semester Third (Contract Hours: 28 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
BTAR301-18	Industrial Automation and Robotics	4	0	0	4	40	60	100	4
BTAR302-18	Strength of Materials	3	1	0	4	40	60	100	4
BTAM 302-23	Mathematics –III (Probability & Statistics)	4	1	0	4	40	60	100	4
BTAR304-18	Fluid Mechanics and Fluid Machines	3	1	0	4	40	60	100	4
BTAR305-18	Kinematics and Theory of Machines	3	1	0	4	40	60	100	4
BTAR306-18	Strength of Materials Lab	0	0	2	2	30	20	50	1
BTAR307-18	Fluid Mechanics and Fluid Machines Lab	0	0	2	2	30	20	50	1
BTAR308-18	Kinematics and Theory of Machines Lab	0	0	2	2	30	20	50	1
BMPD301-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**290**	**360**	**650**	**23**

BTAR301-18 INDUSTRIAL AUTOMATION AND ROBOTICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objective-The course elaborates introduction and applications of automation & robotics and basic knowledge of pneumatic and hydraulic system. It gives an overview of different components of hydraulic & pneumatic system and design the circuit by apply the different methods.

Course Outcome-

CO1. Student will be able to understand the basics of industrial automation.
CO2. Student will be able to understand basic hydraulic and pneumatic components and circuits.
CO3. Design of pneumatic and hydraulic logic circuits for a given sequence
CO4. Student will be able to understand the different gate system and methods in mechanical and automation system.
CO5. Student will be able to understand the basics of industrial robot and its applications.

Detailed Contents:

1. **Introduction:** Concept and scope of automation: Socio economic impacts of automation, Types of Automation, Low Cost Automation
2. **Fluid Power:** Fluid power control elements, Standard graphical symbols, Fluid power generators, Hydraulic and pneumatic Cylinders - construction, design and mounting; Hydraulic and pneumatic Valves for pressure, flow and direction control.
3. **Basic hydraulic and pneumatic circuits:** Direct and Indirect Control of Single/Double Acting Cylinders, designing of logic circuits for a given time displacement diagram & sequence of operations, Hydraulic & Pneumatic Circuits using Time Delay Valve & Quick Exhaust Valve, Memory Circuit & Speed Control of a Cylinder, Troubleshooting and "Causes & Effects of Malfunctions" Basics of Control Chain, Circuit Layouts, Designation of specific Elements in a Circuit.
4. **Fluidics:** Boolean algebra, Truth Tables, Logic Gates, Coanda effect.
5. **Electrical and Electronic Controls:** Basics of Programmable logic controllers (PLC), Architecture & Components of PLC, Ladder Logic Diagrams
6. **Transfer Devices and feeders:** Classification, Constructional details and Applications of Transfer devices, Vibratory bowl feeders, Reciprocating tube, Centrifugal hopper feeders
7. **Robotics:** Introduction, Classification based on geometry, control and path movement, Robot Specifications, Robot Performance Parameters, Robot Programming, Machine Vision, Teach pendants, Industrial Applications of Robots

Suggested Readings/Books:

1. Anthony Esposito, Fluid Power with applications, Pearson
2. S. R Majumdar, Pneumatic Control, McGraw Hill
3. S. R Deb, Robotic Technology and Flexible Automation, Tata Mc Hill
4. Saeed B. Niku Introduction to Robotics, Wiley India
5. Ashitava Ghosal, Robotics, Oxford

BTAR302-18 STRENGTH OF MATERIALS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the nature of stresses developed in simple geometries such as bars cantilevers, beams, Shafts, cylinders and spheres for various types of simple loads.
2. To calculate the elastic deformation occurring in various simple geometries for different types of loading.

Detailed Contents:

1. Deformation in solids- Hooke's law, stress and strain- tension, compression and shear stresses- elastic constants and their relations- volumetric, linear and shear strains- principal stresses and principal planes- Mohr's circle.
2. Beams and types, transverse loading on beams- shear force and bending moment diagrams-Types of beam supports, simply supported and over-hanging beams, cantilevers. Theory of bending of beams, bending stress distribution and neutral axis, shear stress distribution, point and distributed loads.
3. Moment of inertia about an axis and polar moment of inertia, deflection of a beam using double Integration method, computation of slopes and deflection in beams, Maxwell's reciprocal theorem.
4. Torsion, stresses and deformation in circular and hollow shafts, stepped shafts, deflection of shafts fixed at ends, stresses and deflection of helical springs.
5. Axial and hoop stresses in cylinders subjected to internal pressure, deformation of thick and thin cylinders, deformation in spherical shells subjected to internal pressure

Course Outcomes:

1. Students should be able to recognize various types of loads applied on machine components of simple geometry and understand the nature of internal stresses that will develop within the components
2. Students will be able to evaluate the strains and deformation that will result due to the elastic stresses developed within the materials for simple types of loading

Suggested Readings/Books:

1. Egor P. Popov, Engineering Mechanics of Solids, Prentice Hall of India, New Delhi, 2001.
2. R. Subramanian, Strength of Materials, Oxford University Press, 2007.
3. Ferdinand P. Been, Russel Johnson Jr and John J. Dewole, Mechanics of Materials, Tata McGraw Hill Publishing Co. Ltd., New Delhi 2005.
4. S. S. Rattan, "Strength of Materials", Tata McGraw Hill, New Delhi.
5. R. K. Bansal, "A Text Book of Strength of Materials", Laxmi Publications, New Delhi.
6. D. K. Singh, "Strength of Materials", Ane Books Pvt. Ltd., New Delhi.
7. Sadhu Singh, Strength of Materials, Khanna Publishers, Delhi.

BTAM 302-23 MATHEMATICS-III (Probability and Statistics)

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	1	0	4	40	60	100	4

Pre-requisite: Intermediate Calculus and Basic algebra

Course Objectives: The objective of this course is to familiarize the students with fundamental concepts of theory of probability and statistics. The major focus of the course will be on a systematic mathematical treatment of these concepts and their applications.

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

CO1	Analyze given data using measures of central tendency, skewness and kurtosis.
CO2	Understand and deal with randomness occurring in real world phenomena.
CO3	Apply theoretical discrete and continuous probability distributions to deal with real world problems.
CO4	Analyze given data using the concepts of correlation and regression and fitting of curves.
CO5	Analyze hypothesis based on small and large samples using different tests of significance.

Detailed Content:

Unit I

Measures of Central tendency: Moments, skewness and Kurtosis, Random experiment, Probability axioms, Definition of Probability, conditional probability, Discrete and Continuous random variables, Expectation of Discrete and Continuous random variables.

Unit II

Probability distributions: Binomial, Poisson and Normal, Poisson approximation to the binomial distribution, Evaluation of statistical parameters for these three distributions, Bivariate distributions and their properties.

Unit III

Correlation and regression for bivariate data, Rank correlation. Curve fitting by the method of least squares, fitting of straight lines, second degree parabolas and more general curves.

Unit IV

Test of significances: Sampling and standard error, Tests of significance for large samples and small samples (t-distribution, F-distribution), Chi-square test for goodness of fit and independence of attributes.

Recommended Books:

1. S.P. Gupta, Statistical Methods, Sultan Chand & Sons, 33rd Edition, 2005.
2. S.C. Gupta and V. K. Kapoor, Fundamentals of Mathematical Statistics, Sultan Chand & Sons, 2014.
3. S. Ross, A First Course in Probability, 6th Edition, Pearson Education India, 2002.
4. N.P. Bali and Manish Goyal, A text book of Engineering Mathematics, Laxmi Publications, Reprint, 2010.
5. Robert V. Hogg, Joseph W. Mckean and Allen T. Craig, Introduction to Mathematical Statistics, 7th Edition, Pearson, 2012.

BTAR304-18 FLUID MECHANICS AND FLUID MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To learn about the application of mass and momentum conservation laws for fluid flows.
2. To understand the importance of dimensional analysis.
3. To obtain the velocity and pressure variations in various types of simple flows.
4. To analyze the flow in water pumps and turbines.

Detailed Contents:

1. Definition of fluid, Newton's law of viscosity, Units and dimensions-Properties of fluids, mass density, specific volume, specific gravity, viscosity, compressibility and surface tension, Control volume- application of continuity equation and momentum equation, Incompressible flow, Bernoulli's equation and its applications.
2. Exact flow solutions in channels and ducts, Couette and Poisuielle flow, laminar flow through circular conduits and circular annuli- concept of boundary layer – measures of boundary layer thickness – Darcy Weisbach equation, friction factor, Moody's diagram.
3. Need for dimensional analysis – methods of dimension analysis – Similitude – types of similitude Dimensionless parameters – application of dimensionless parameters – Model analysis.
4. Euler's equation – theory of Rotodynamic machines – various efficiencies – velocity components at entry and exit of the rotor, velocity triangles – Centrifugal pumps, working principle, work done by the impeller, performance curves – Cavitation in pumps- Reciprocating pump – working principle.
5. Classification of water turbines, heads and efficiencies, velocity triangles- Axial, radial and mixed flow turbines- Pelton wheel, Francis turbine and Kaplan turbines, working principles – draft tube- Specific speed, unit quantities, performance curves for turbines – governing of turbines.

Course Outcomes:

1. Students will be able to mathematically analyze simple flow situations.
2. They will be able to evaluate the performance of pumps and turbines.

Suggested Readings/Books:

1. D.S. Kumar, Fluid Mechanics and Fluid Power Engineering, S.K. Kataria and Sons Publishers.
2. S.K. Som, G. Biswas and S. Chakraborty, Introduction to Fluid Mechanics and Fluid Machines, Tata McGraw Hill.
3. R.L. Daughaty, Hydraulic Turbines, McGraw Hill.
4. K. Subramaniam, Hydraulic Machines, Tata Mc Graw Hill.

BTAR305-18 KINEMATICS AND THEORY OF MACHINES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To understand the kinematics and rigid- body dynamics of kinematically driven machine components
2. To understand the motion of linked mechanisms in terms of the displacement, velocity and acceleration at any point in a rigid link
3. To understand the kinematics of gear trains

Detailed Contents:

1. Classification of mechanisms- Basic kinematic concepts and definitions- Degree of freedom, mobility- Grashof's law, Kinematic inversions of four bar chain and slider crank chains- Limit positions- Mechanical advantage- Transmission angle- Description of some common mechanisms- Quick return mechanism, straight line generators- Universal Joint- Rocker mechanisms

2. Displacement, velocity and acceleration analysis of simple mechanisms, graphical velocity analysis using instantaneous centers, velocity and acceleration analysis using loop closure equations- kinematic analysis of simple mechanisms- slider crank mechanism dynamics Coincident points- Coriolis component of acceleration- introduction to linkage synthesis, three position graphical synthesis for motion and path generation

3. Classification of cams and followers- Terminology and definitions- Displacement Diagrams-Uniform velocity, parabolic, simple harmonic and cycloidal motions- derivatives of follower motions-specified contour cams- circular and tangent cams- pressure angle and undercutting, sizing of cams, graphical and analytical disc cam profile synthesis for roller and flat face followers

4. Involute and cycloidal gear profiles, gear parameters, fundamental law of gearing and conjugate action, spur gear contact ratio and interference/undercutting- helical, bevel, worm, rack & pinion gears, epicyclic and regular gear train kinematics

5. Surface contacts- sliding and rolling friction- friction drives- bearings and lubrication friction clutches- belt and rope drives- friction in brakes

Course Outcomes:

1. Students can design various types of linkage mechanisms for obtaining specific motion andanalyze them for optimal functioning

Suggested Readings/Books:

1. Thomas Bevan, Theory of Machines, 3rd edition, CBS Publishers & Distributors, 2005.
2. Cleghorn W.L., Mechanisms of Machines, Oxford University Press, 2005.
3. Robert L. Norton, Kinematics and Dynamics of Machinery, Tata McGraw Hill, 2009.
4. Ghosh A. and Mallick A.K., Theory of Mechanisms and Machines, Affiliated East-West Pvt. Ltd, New Delhi, 1988.

BTAR306-18 STRENGTH OF MATERIALS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To understand the procedure of doing different tests like hardness, compression, torsion, tension and impact etc. in various materials.
2. To impart knowledge about the testing of springs and beams and behavior of materials.

List of experiments:

1. To perform tensile test in ductile and brittle materials and to draw stress-strain curve and to determine various mechanical properties.
2. To perform compression test on Cast Iron.
3. To perform any one hardness tests (Rockwell, Brinell & Vicker's test).
4. To perform impact test to determine impact strength.
5. To perform torsion test and to determine various mechanical properties.
6. To perform Fatigue test on circular test piece.
7. To perform bending test on beam and to determine the Young's modulus and modulus of rupture.
8. Determination of Bucking loads of long columns with different end conditions.

Course Outcomes:

1. Describe the behavior of materials upon normal external loads.
2. Predict the behavior of the material under impact conditions.
3. Recognize the mechanical behavior of materials.

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BTAR307-18 FLUID MECHANICS AND FLUID MACHINES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To provide practice in estimating friction losses.
2. To impart training to use various flow measuring devices for making engineering judgments.

List of experiments:

1. To determine the metacentric height of a floating vessel under loaded and unloaded conditions.
2. To study the flow through a variable area duct and verify Bernoulli's energy equation.
3. To determine the coefficient of discharge for an obstruction flow meter (venturi meter/ orifice meter)
4. To determine the discharge coefficient for a V- notch or rectangular notch.
5. To determine the friction coefficients for pipes of different diameters.
6. To determine the head loss in a pipe line due to sudden expansion/ sudden contraction/ bend.
7. To determine the velocity distribution for pipeline flow with a pitot static probe.
8. To draw characteristics of Francis turbine/Kaplan Turbine
9. To study the constructional features of reciprocating pump and to perform test on it for determination of pump performance
10. To draw the characteristics of Pelton Turbine
11. To draw the various characteristics of Centrifugal pump

Course Outcomes:

1. Estimate the friction and measure the frictional losses in fluid flow.
2. Experiment with flow measurement devices like venturimeter and orifice meter.
3. Predict the coefficient of discharge for flow through pipes.

BTAR308-18 KINEMATICS AND THEORY OF MACHINES LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To equip students with understanding of the fundamental principles and techniques for identifying different types of dynamic systems and classify them by their governing equations.
2. To develop a model of a mechanical system using a free body diagram.
3. To develop equations of motion for translational and rotational mechanical systems.

List of experiments:

1. To draw displacement, velocity & acceleration diagram of slider - crank and four bar mechanism.
2. To study the various inversions of kinematic chains.
3. Conduct experiments on various types of governors and draw graphs between height and equilibrium speed of a governor.
4. Determination of gyroscopic couple (graphical method).
5. Balancing of rotating masses (graphical method).
6. Cam profile analysis (graphical method)
7. Determination of gear- train value of compound gear trains and epicyclic gear trains.
8. To draw circumferential and axial pressure profile in a full journal bearing.
9. To determine coefficient of friction for a belt-pulley material combination.
10. Determination of moment of inertia of flywheel.

Course Outcomes:

1. Compute the moment of inertia of rigid bodies.
2. Demonstrate the working principles of gyroscope and cam.
3. Experiment with vibrations and balancing.

Semester Fourth (Contract Hours: 28 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Mark s	Credit points
BTAR401-18	Design of Machine Elements	4	1	0	5	40	60	100	5
BTAR402-18	Manufacturing Technology	4	0	0	4	40	60	100	4
BTAR403-18	Hydraulic and Pneumatics	4	0	0	4	40	60	100	4
BTAR404-18	Basic Electronics Engineering	3	0	0	3	40	60	100	3
BTAR405-18	Industrial Safety	3	0	0	3	40	60	100	3
EVS101-18	Environment Science	3	0	0	3	100	00	100	Non Credit
BTAR406-18	Manufacturing Technology Lab	0	0	2	2	30	20	50	1
BTAR407-18	Hydraulic and Pneumatics Lab	0	0	2	2	30	20	50	1
BMPD401-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**360**	**340**	**700**	**21**

BTAR401-18 DESIGN OF MACHINE ELEMENTS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	1	0	5	40	60	100	5

Objectives:

1. To teach students how to apply the concepts of stress analysis, theories of failure and material science to analyze, design and/or select commonly used machine components.
2. To illustrate to students the variety of mechanical components available and emphasize the need to continue learning.
3. To teach students how to apply mechanical engineering design theory to identify and quantify machine elements in the design of commonly used mechanical systems.

Detailed Contents:

1. Scope and meaning of machine design. Sources of design data. Design considerations from economics, manufacturing, aesthetics and ergonomics aspects. Design Process, Selection of Materials.

2. Screwed Joints

Design of Bolted joints, Bolted Joints under eccentric Loading. Welded Joints: - Design of Fillet Welded Joints, Butt Joints, Un-symmetric Welded sections, eccentrically loaded welded joints.

3. Riveted Joints

Design of Lap Joints, Butt Joints, Diamond Riveting, Eccentrically loaded riveted joints, Design of Cotter and Knuckle Joints.

4. Shafts

Design of shafts under different types of loading conditions.

5. Keys & Couplings

Design of rectangular and square keys, muff coupling, split muff coupling, flange coupling, bushed-pin flexible coupling.

6. Levers

Design of straight levers, Bell - Crank levers, foot levers, hand levers.

7. Brakes and Clutches

Design of friction plate and cone clutches simple type brakes.

8. Introduction to Design for Manufacturing and Assembly.

Course Outcomes:

Students will get an overview of the design methodologies employed for the design of various machine components.

Suggested Readings/Books

1. J.E. Shigley, Mechanical Engineering**,** McGraw-Hill Education (India) Pvt Ltd.
2. Dr. Sadhu Singh, Machine Design, Khanna Publishers.
3. R.S.Khurmi & J.K.Gupta, A text book of machine design**,** S. Chand & Co.
4. D.K.Aggarwal & P.C.Sharma, Machine Design**,** S.K Kataria and Sons.
5. Krishnamurthi, Design and Manufacturing S.K. Kataria and Sons.

BTAR402-18 MANUFACTURING TECHNOLOGY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To provide knowledge on machines and related tools for manufacturing various components.
2. To understand the relationship between process and system in manufacturing domain.
3. To identify the techniques for the quality assurance of the products and the optimality of the process in terms of resources and time management.

Detailed Contents:

1. Tooling for conventional and non-conventional machining processes: Mould and die design, Press tools, Cutting tools; Holding tools: Jigs and fixtures, principles, applications and design; presstools – configuration, design of die and punch; principles of forging die design.

2. Metrology: Dimensions, forms and surface measurements, Limits, fits and tolerances; linear and angular measurements; comparators; gauge design; interferometry; Metrology in tool wear and part quality including surface integrity, alignment and testing methods; tolerance analysis in manufacturing and assembly. Process metrology for emerging machining processes such as micro-scale machining, Inspection and workpiece quality.

3. Assembly practices: Manufacturing and assembly, process planning, selective assembly, Material handling and devices.

4. Linear programming, objective function and constraints, graphical method, Simplex and duplex algorithms, transportation assignment, Traveling Salesman problem; Network models: shortest route, minimal spanning tree, maximum flow model- Project networks: CPM and PERT, critical path scheduling; Production planning & control: Forecasting models, aggregate production planning, materials requirement planning. Inventory Models: Economic Order Quantity, quantity discount models, stochastic inventory models, practical inventory control models, JIT. Simple queuing theory models.

Course Outcomes:

Students will be able to recognize the tooling needed for manufacturing, the dimensional accuracy and tolerances of products, assembly of different components and the application of optimization methods in manufacturing.

Suggested Readings/Books:

1. Kalpakjian and Schmid, Manufacturing processes for engineering materials (5th Edition)- Pearson India, 2014.
2. Taha H. A., Operations Research, 6th Edition, Prentice Hall of India, 2003.
3. Shenoy G.V. and Shrivastava U.K., Operations Research for Management, Wiley Eastern, 1994.

BTAR403-18 HYDRAULIC AND PNEUMATICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:
The course elaborates principles of hydraulic and pneumatic devices, electro-pneumatic components. It gives an overview of control systems associated with hydraulic applications.

Detailed Contents:

1. **Fluid Power Principles and Fundamentals**

Introduction to fluid power, Advantages and applications, Fluid power systems, Types and Properties of Hydraulic fluids, Basics of hydraulics, Principles of flow, Work, Power and Torque, Reynolds number, Influence of temperature on viscosity, High water-based fluid, Fluid preparation, Common fire-resistant fluid**,** Biodegradable oils**.**

2. **Hydraulic Linear Actuators**

Hydraulic cylinder, Construction of cylinders, Seals in cylinders, Cylinder reliability, Cylinder force, Acceleration and losses, Calculation of cylinder forces, Flow velocity, Cylinder efficiency, Sizing of cylinder tubes, Piston rod design, mounting style of cylinders, Cushioning of hydraulic cylinder, Hydraulic cylinder and their characteristic application.

3. **Hydraulic motors**

Vane Motor, Gear Motor, Piston motor, Selection of hydro motor, Hydraulic or electrical motor,Hydraulic motor in circuits, Types of hydraulic transmission, Pump motor combination, Open loop and close loop system, Application of hydrostatic transmission.

4. **Filter and Filtration**

Nature, effect and sources of contamination, Effect of dirt on hydraulic components, System failure, Contamination level and standardization, Filter rating, Terminology and Design types of filters and Filter construction, Location of filter, Magnetic filter, Optimum filtration, Automatic particle counter and its performance characteristics.

5. **Hydraulic Pumps**

Pump classification-Gear Pump, Internal Gear pump, Gerotor Pump, Screw Pump, Vane Pump, Piston Pumps, Selecting and sizing of Hydraulic pumps, Pump ripple.

6. **Hydraulic Reservoir and Accumulators**

Common types of reservoirs- their mounting and construction, Reservoir shapes and size, Reservoir accessories, Integral reservoirs, Hydraulic accumulator, Accumulators in circuit, Accumulator selection.

7. **Hydraulic Circuits**

Hydraulic circuits, Manual or Automatic Hydraulic systems, Regenerative circuits, Use of check Valve in hydraulic circuits, Standards in circuit diagram representation, Speed variation in cylinder motion, Some basic circuits, Functional diagram, Application of functional diagram, Electrical control of hydraulic system.

8. **Hydro Pneumatic**

Compressibility, Solution, Types of hydro Pneumatic systems, Hydraulic check unit, Hydro pneumatic cylinder, Parallel check unit, Integral air oil cylinder, Types of feed, Intensifier, Comparison of Hydro pneumatic, Hydraulic and pneumatic system.

9. Automation and Principle of Pneumatic Circuit Design

Pneumatic controls, Functional diagram in pneumatic circuit, Movement diagram, Cascade system of Pneumatic circuit design.

10. Maintenance and Trouble Shooting of Pneumatic system

Maintenance need of Pneumatic systems, Common problems in Pneumatic system, Maintenance schedule of Pneumatic system, Trouble shooting, Maintenance tips, Flow resistance, Seal failures, Maintenance of air compressor, Instructions for removal of operating troubles of air compressor.

Course Outcomes:

1. Demonstrate knowledge of fundamental concepts of Pneumatic and Hydraulic control.
2. Identify various components of Pneumatic and Hydraulic control systems.
3. Design and analyze problems relating to Pneumatic and Hydraulic control systems and components.

Suggested Readings/Books:

1. S.R. Majumdar, Oil Hydraulic Systems-Principles and Maintenance, Tata McGraw Hill.
2. S.R. Majumdar, Pneumatic Systems-Principles and Maintenance, Tata McGraw Hill.
3. Farel Bradbury, Hydraulic Systems and Maintenance, Butterworth & Co (Publishers) Ltd.
4. R. Srinivasan, Hydraulic and Pneumatic Controls, Vijay Nicole.
5. Anthony Esposito, Fluid Power with Applications, PHI/Pearson Education.

BTAR404-18 BASIC ELECTRONICS ENGINEERING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:
To provide an overview of electronic device components to students.

Detailed Contents:

1. **Semiconductor Devices and Applications**: Introduction to P-N junction Diode and V-I characteristics, Half wave and Full-wave rectifiers, capacitor filter. Zener diode and its characteristics, Zener diode as voltage regulator. Regulated power supply IC based on 78XXand 79XX series, Introduction to BJT, its input-output and transfer characteristics, BJT as a singlestage CE amplifier, frequency response and bandwidth.
2. **Operational amplifier and its applications:** Introduction to operational amplifiers, Op-amp input modes and parameters, Op-amp in open loop configuration, op-amp with negative feedback, study of practical op-amp IC 741, inverting and non-inverting amplifier applications: summing and difference amplifier, unity gain buffer, comparator, integrator and differentiator.
3. **Timing Circuits and Oscillators:** RC-timing circuits, IC 555 and its applications as a stable and mono-stable multi-vibrator, positive feedback, Barkhausen's criteria for oscillation, R-C phase shift and Wein bridge oscillator.
4. **Digital Electronics Fundamentals:** Difference between analog and digital signals, Number System, Boolean algebra, Basic and Universal Gates, Symbols, Truth tables.
5. **Electronic Communication Systems**: The elements of communication system, IEEE frequency spectrum, Transmission media: wired and wireless, need of modulation, AM and FM modulation schemes, Mobile communication systems: cellular concept and block diagram of GSM system.

Course Outcomes:
1. Understand the principles of semiconductor devices and their applications.
2. Design an application using Operational amplifier.
3. Understand the working of timing circuits and oscillators.
4. Understand logic gates, flip flop as a building block of digital systems.
5. Learn the basics of Electronic communication system.

Suggested Readings/Books:
1. Floyd ," Electronic Devices" Pearson Education 9th edition, 2012.
2. R.P. Jain , "Modern Digital Electronics", Tata Mc Graw Hill, 3rd Edition, 2007.
3. Frenzel, "Communication Electronics: Principles and Applications", Tata Mc GrawHill, 3rd Edition, 2001

BTAR405-18 INDUSTRIAL SAFETY

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Objectives:

1. To know about Industrial safety programs and toxicology, Industrial laws, regulations and source models
2. To understand about fire and explosion, preventive methods, relief and its sizing methods
3. To analyze industrial hazards and its risk assessment.

Detailed Contents:

1. Safety

Meaning & need for safety, Relationship of safety with plant design, Equipment design and work environment, Industrial accidents, Natures, Types and causes.

2. Assessment of Accident Costs

Prevention of accidents, Industrial hazards, Hazard identification techniques, Accident investigation, Reporting and analysis.

3. Planning for Safety

Definition, Purpose, Nature, Scope and procedure, Range of planning, Variety of plans, Policy formulation and implementation of safety policies, Safety measures in a manufacturing organization, Safety, Economics, Safety and productivity, Employees participation in safety, Safety standards and legislation.

4. Meaning of Environment and Need for Environmental Control

F-factors in industry, Effect of temperature, Illumination, Humidity, Noise and vibrations on human body and mind. Measurement and mitigation of physical and mental "fatigue", Basics of environment design for improved efficiency and accuracy at work.

5. Ventilation and Heat

Control Purpose of ventilation, Physiology of heat regulation, Thermal environment and its measurement, Thermal comfort, Indices of heat stress, Thermal limits for comfort, Efficiency and freedom from health risk, Natural ventilation and mechanical ventilation, Air conditioning Process ventilation, Control of heat exposures, Control at source, Insulation and local exhaust ventilation, Control of radiant heat, Dilution ventilation, Local relief.

6. Industrial Lighting

Purpose of lighting, Benefits of good illumination, Phenomenon of lighting and safety, Lighting at work, Sources and types of artificial lighting, Principles of good illumination, recommended optimum standards of illumination, design of lighting installation, Maintenance standards relating to lighting and colour.

7. Noise & Vibrations

Continuous and impulse noise, Effect of noise on man, Noise measurement and evaluation of noise, Noise isolation. Noise absorption techniques, Silencers vibrations: Effect, Measurement and control measures.

8. Environment Standards

Introduction to ISO-14000, Environment standards for representative industries

Course Outcomes:

1. Analyze the effect of release of toxic substances
2. Understand the industrial laws, regulations and source models.
3. Apply the methods of prevention of fire and explosions.
4. Understand the relief and its sizing methods.
5. Understand the methods of hazard identification and preventive measures.

Suggested Readings/Books:

1. Joselin, Ventilation, Edward Arnold.
2. Beranek, Noise Reduction, McGraw Hill.
3. Reamer D.C., Modern Safety and health Technology, R. Wiley.
4. Heinrich H.W, Industrial Accident Prevention, McGraw Hill.
5.Firenze, The process of Hazard Control, R.J. Kendale.

3. Apply the methods of prevention of fire and explosions.
4. Understand the relief and its sizing methods.
5. Understand the methods of hazard identification and preventive measures.

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1. Joselin, Ventilation, Edward Arnold.
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3. Reamer D.C., Modern Safety and health Technology, R. Wiley.
4. Heinrich H.W, Industrial Accident Prevention, McGraw Hill.
5.Firenze, The process of Hazard Control, R.J. Kendale.

EVS101-18 ENVIRONMENT SCIENCE

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	100	00	100	Non Credit

Objectives

We as human being are not an entity separate from the environment around us rather; we are a constituent seamlessly integrated and co-exist with the environment around us. We are not an entity so separate from the environment that we can think of mastering and controlling it rather we must understand that each and every action of ours reflects on the environment and vice versa. Ancient wisdom drawn from Vedas about environment and its sustenance reflects these ethoses. There is a direct application of this wisdom even in modern times. Idea of an activity-based course on environment protection is to sensitize the students.

Detailed Contents:

Module 1: Natural Resources: Renewable and non-renewable resources

Natural resources and associated problems.

a) Forest resources: Use and over-exploitation, deforestation, case studies. Timber extraction, mining, dams and their effects on forest and tribal people.
b) Water resources: Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.
c) Mineral resources: Use and exploitation, environmental effects of extracting and using mineral resources, case studies.
d) Food resources: World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.
e) Energy resources: Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources. Case studies.
f) Land resources: Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

- Role of an individual in conservation of natural resources.
- Equitable use of resources for sustainable lifestyles.

Module 2: Ecosystems

Concept of an ecosystem. Structure and function of an ecosystem. Food chains, food webs and ecological pyramids. Introduction, types, characteristic features, structure and function of following ecosystems:

a. Forest ecosystem
b. Aquatic ecosystems (ponds, streams, lakes, rivers, oceans, estuaries)

Module 3: Biodiversity and its conservation

- Introduction – Definition: genetic, species and ecosystem diversity.
- Biodiversity at global, National and local levels.
- Inida as a mega-diversity nation
- Hot-sports of biodiversity.
- Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts.
- Endangered and endemic species of India

Module 4: Social Issues and the Environment

- From Unsustainable to Sustainable development
- Resettlement and rehabilitation of people; its problems and concerns.
- Environmental ethics: Issues and possible solutions.
- Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust. Case Studies.
- Public awareness.

***ACTIVITIES**

Nature club (bird watching, recognizing plants at institute/at home, recognizing local animals, appreciating biodiversity

Impart knowledge and inculcate the habit of taking interest and understanding biodiversity in and around the college campus. The students should be encouraged to take interest in bird watching, recognizing local plants, herbs and local animals. The students should be encouraged to appreciate the difference in the local biodiversity in their hometown, in the place of their study and other places they visit for vacation/breaks etc.

Following activities must be included.

- Identify a tree fruit flower peculiar to a place or having origin from the place.
- Making high resolution big photographs of small creatures (bees, spiders, ants. mosquitos etc.) especially part of body so that people can recognize (games on recognizing animals/plants).
- Videography/ photography/ information collections on specialties/unique features of different types of common creatures.
- Search and explore patents and rights related to animals, trees etc. Studying miracles of mechanisms of different body systems.

1*(A) Awareness Activities:*

a) Small group meetings about water management, promotion of recycle use, generation of less waste, avoiding electricity waste
b) Slogan making event
c) Poster making event
d) Cycle rally
e) Lectures from experts
f) Plantation
g) Gifting a tree to see its full growth
h) Cleanliness drive
i) Drive for segregation of waste
j) To live with some eminent environmentalist for a week or so to understand his work
k) To work in kitchen garden for mess
l) To know about the different varieties of plants
m) Shutting down the fans and ACs of the campus for an hour or so
n) Visit to a local area to document environmental assets river/ forest/ grassland /hill/ mountain/ lake/ Estuary/ Wetlands
o) Visit to a local polluted site-Urban/Rural/Industrial/Agricultural
p) Visit to a Wildlife sanctuary, National Park or Biosphere Reserve

Course Outcomes:

1. Students will enable to understand environmental problems at local and national level through literature and general awareness.
2. The students will gain practical knowledge by visiting wildlife areas, environmental institutes and various personalities who have done practical work on various environmental Issues.

Suggested Readings/Books

1. Agarwal, K.C. 2001 Environmental Biology, Nidi Publ. Ltd. Bikaner.
2. Bharucha Erach, The Biodiversity of India, Mapin Publishing Pvt. Ltd., Ahmedabad.
3. Brunner R.C., 1989, Hazardous Waste Incineration, McGraw Hill Inc.
4. Clark R.S., Marine Pollution, Clanderson Press Oxford (TB)
5. Cunningham, W.P. Cooper, T.H. Gorhani, E & Hepworth, M.T. 2001, Environmental Encyclopedia, Jaico Publ. House, Mumabai.
6. Hawkins R.E., Encyclopedia of Indian Natural History, Bombay Natural History Society, Bombay (R)
7. Heywood, V.H & Waston, R.T. 1995. Global Biodiversity Assessment. Cambridge Univ. Press.

BTAR406-18 MANUFACTURING TECHNOLOGY LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To impart students with the knowledge of various machine tools and its operations.
2. To familiarize with the selection of suitable production process for the desired component

List of experiments:

- Measurement of cutting temperature and tool life in turning and machine tool alignment test on machine tools.
- Pattern Making; pattern material, pattern allowances and types of patterns. Mould making Practice: Uses of moulding tools: green sand moulding, gating system, risering system, core making.
- Method Study on Bolt, Washer and Nut Assembly
- Flow Process Chart [Man Type/Material Type] 4. Man-Machine
- Study & use of software for Inventory control, Facility Design, Process planning, Production control. Study of simulation software and applications in material flow.
- Integrated automation, computers and managerial challenges.
- Modern cutting tools and tool management, CAPP, high speed machining, precision machining.

Course Outcomes:

1. Explain the working principle of various machines used in manufacturing.
2. Identify the appropriate production process and machines.
3. Demonstrate the working of advance machine tools.

BTAR 407-18 HYDRAULIC AND PNEUMATICS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

Objectives:

1. To provide knowledge on electrical circuits, signal conditioning
2. To make familiar about control system and power electronics in designing hydraulic and pneumatic systems.

List of experiments:

1. Design and testing of hydraulic circuits using-

i. Pressure control

ii. Flow control

iii. Direction control

2. Design of circuit with programmed logic sequence, using an optional PLC in hydraulic Electro- hydraulic Trainer.

3. Design and testing of pneumatic circuits using-

i. Pressure control

ii. Flow control

iii. Direction control

iv. Circuits with logic controls

v. Circuits with timers

vi. Circuits with multiple cylinder sequences in pneumatic electro pneumatic trainer.

4. Design of circuits using mechanical feedback systems.

5. Velocity control of single and double acting hydraulic and pneumatic cylinders.

6. Design of Pneumatic system using any commercially available simulation software.

7. Design of Hydraulic system using any commercially available simulation software.

Course Outcomes:

1. Describe hydraulic and pneumatic systems and overview of control systems & actuators.
2. Differentiate between various sensors, transducers and actuators and their applications.
3. Relate various signal conditioning units, amplifiers, logic gates and their role in programmable logic controllers.

Semester Fifth (Contract Hours: 28 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR501-18	Electronics Devices and Circuits	4	0	0	4	40	60	100	4
BTAR502-18	Computer Aided Design and Manufacturing	4	0	0	4	40	60	100	4
BTAR503-18	Robotics Engineering and Applications	4	0	0	4	40	60	100	4
BTAR504-18	Digital Electronics	3	0	0	3	40	60	100	3
HSMC101-18 / HSMC102-18*	Humanities -I	3	0	0	3	40	60	100	3
BTAR505-18	Electronics Devices and Circuits Lab	0	0	2	2	30	20	50	1
BTAR506-18	Computer Aided Design and Manufacturing Lab	0	0	2	2	30	20	50	1
BTAR507-18	Digital Electronics Lab	0	0	2	2	30	20	50	1
BTAR508-18	German/Japanese/ French Language Lab	0	0	2	2	30	20	50	1
BMPD501-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**320**	**380**	**700**	**22**

BTAR-501-18 ELECTRONIC DEVICES AND CIRCUITS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Course Outcomes At the end of this course student will be able to:

CO1. Understand the biasing of transistors and analyze JFET/MOSFET.

CO2. Analyze various rectifiers and regulator circuits.

CO3. Understand operational amplifiers and its different applications.

CO4. Understand working and realization of combinational circuits and sequential circuits.

CO5. Understand some specialized ICs.

Detailed Contents:

1. **Semiconductor devices**
   H parameters equivalent circuit, Common emitter amplifier, DC behavior: the load slope and the Q point, AC behavior, Emitter follower amplifier, Field effect transistors: JFET and MOSFET.
2. **Power supplies**
   Review of Rectification with and without filters, Linear regulators. 78XX and 79XX family. Switching regulators.
3. **Operational amplifiers Fundamentals & Applications**
   Basic opamp circuit, Opamp parameters, Opamps as DC Amplifiers, Voltage followers, Non- Inverting and Inverting Amplifier, Summing and Difference Amplifier, Opamp as AC Amplifier, Opamp Frequency Response, Opamp Applications as Voltage Source, Current Source, Current Amplifiers, Instrument Amplifiers, Precision Half Wave and Full Wave Rectifier, Limiters, Clampers, Peak Detectors, Sample and Hold Circuits, V-I and I-V converter, Schmitt Trigger.
4. **Opamp applications as Voltage Regulator, Timer and Data Converters**
   IC 555 Timer used as Astable and Monostable Multivibrator, PLL, VCO, D-A and A-D Converter.
5. **Digital Techniques: combinational circuits and sequential circuits**
   Truth tables. Karnaugh's diagram. Miniterm addition. Maxiterm product. Synthesis of combinational circuits. Logic comparators. Codifiers. Decodifiers. Multiplexers, de-multiplexers. Basic Bistable Element, Latches, A SR Latch, Application of SR Latch, The SR Latch, The gated SR Latch, The gated D Latch, The Master-Slave Flip-Flops (Pulse- Triggered Flip-Flops): The Master-Slave SR Flip-Flops, The Master-Slave JK Flip-Flop, Edge Triggered Flip-Flop: The Positive Edge-Triggered D Flip-Flop, Negative-Edge Triggered D Flip-Flop.
6. **Analysis of Sequential Circuits**
   Registers and Counters, Binary Ripple Counters, Synchronous Binary counters, Ring and Johnson Counters, Design of a Synchronous counters, Design of a Synchronous Mod-n Counter using clocked JK Flip-Flops Design of a Synchronous Mod-n Counter.
7. **Bistable, Monostable and Astable Multivibrator**
   A fixed bias binary, self-biased binary, commutating capacitors, a direct connected binary, Schmitt trigger, emitter coupled binary. Monostable multivibrator, emitter coupled monostable multivibrator, astable emitter coupled multivibrator.

SUGGESTED READING/ BOOKS:

1. Ronald J Tocci, **Fundamentals of Pulse & Digital Circuits**, TMH.
2. David A Bell, **Analog Electronics**, PHI.
3. John M Yarbrough, **Digital Logic Applications and Design**, Thomson Learning, 2001.
4. Millman and Taub, **Pulse Digital and Switching Waveforms,** McGraw Hill Edition.
5. Millman- Halkias, **Electronic Devices & Circuits**, Tata Mcgraw Hill.
6. Boylestad, **Electronic Devices & Circuits Theory**, PHI Learning Pvt Ltd.

BTAR-502-18 COMPUTER AIDED DESIGN AND MANUFACTURING

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Course outcomes: At the end of this course, the students will be able to

1. Create the different wireframe primitives using parametric representations.
2. Create surface primitives using parametric modeling.
3. Create the different solid primitives using the different representation schemes.
4. Apply geometric transformations on the created wireframe, surface and solid models.

Detailed Contents:

1. **Fundamentals of CAD**
   Design process with and without computer; CAD/CAM system and its evaluation criteria, brief treatment of input and output devices, Display devices, Functions of a graphics package and Graphics standard GKS, IGES and STEP .Geometric Transformations: Mathematics preliminaries, matrix representation of 2 and 3 dimensional transformation. Geometric Modeling: Wire frame Model, Solid Modeling, Boundary Representation (B-rep), Conductive Solid Geometry (CSG), Introduction to Parametric and Non Parametric representation of Curves.
2. **NC/CNC Machine Tools**
   NC machine tools- basic components coordinate systems; features of NC machine tools. Computerized Numerical Control (CNC): Tooling for NC machines - tool presetting equipment, flexible tooling, tool length compensation, tool path graphics; NC motion control system; Manual part programming, fixed/floating zero. Block format and codes: Computer assisted part programming. DNC and Adaptive Control: Direct numerical control: Adaptive control in machining system; Combined DNC/CNC system.
3. **Group Technology (GT)**
   Part families; part classification and coding system: Group technology machine cells: Advantages of GT.
4. **Computer Aided Process Planning**
   Introduction and benefits of CAPP. Types of CAPP systems, machinability, data selection systems in CAPP.
5. **Computer Integrated Manufacturing Systems**
   Basic Concepts of CIM: CIM Definition, The meaning of Manufacturing, Types of Manufacturing systems; Need, Elements, Evolution of CIM; Benefits of CIM; Flexible Manufacturing Systems: Physical Components of an FMS. Types of Flexibility, Layout Considerations; FMS benefits.
6. **Automated Material-Handling and Storage Systems**
   Introduction to Material handling system, principles of material handling, material handling equipment, automated guided vehicle systems (AGVS), components of an AGVS, types of AGVS, AGVS guidance system, advantages of AGVSs over other Material handling systems, automated storage and retrieval systems, functions of storage systems, AS/RS components and terminology used, types of AS/RS, conveyer systems. Classification of feeders, parts of feeding devices, different types of feeders

SUGGESTED READING/ BOOKS:

1. Mikell P. Groover, Emory W. Zimmers, CAD/CAM, PHI
2. Automation, Production systems and Computer Integrated Manufacturing: - Groover M. P.PHI
3. Zeid Ibraham, CAD/CAM - theory and Practice, Tata McGraw Hill
4. P. N Rao, CAD/CAM, Tata McGraw Hill
5. Nanua Singh, Approach to computer integrated design and manufacturing, John Wiley and sons.

BTAR-503-18 ROBOTICS ENGINEERING AND APPLICATIONS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Course Outcomes

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

CO1. To understand the introduction and terminology of industrial robot and sensors.
CO2. Student will able to calculate the forward kinematics and inverse kinematics of serial and parallel robots.
CO3. Student will able to understand the robot control system and its components.
CO4. To understand the robot programming and its application.

Detailed Contents:

UNIT I-Introduction History of robots, classification based on geometry, devices, control and path movement, Present status and future trends. Basic components of robotic system. Basic terminology- Accuracy, Repeatability, Resolution, Degree of freedom. Mechanisms and transmission, End effectors, Grippers-different methods of gripping, Mechanical grippers-Slider crank mechanism, Screw type, Rotary actuators, Cam type gripper, Magnetic grippers, Vacuum grippers, Air operated grippers; Specifications of robot.

UNIT II- Drive systems and Sensors Drive system- hydraulic, pneumatic and electric systems Sensors in robot – Touch sensors, Tactile sensor, Proximity and range sensors, Robotic vision sensor, Force sensor, Light sensors, Pressure sensors.

UNIT III- Kinematics and Dynamics of Robots 2D, 3D Transformation, Scaling, Rotation, Translation, Homogeneous coordinates, multiple transformation, Simple problems. Matrix representation, Forward and Reverse Kinematics Of Three Degree of Freedom, Homogeneous Transformations, Inverse kinematics of Robot, Robot Arm dynamics, D-H representation of robots, Basics of Trajectory Planning.

UNIT IV-Robot Control, Programming and Applications Robot controls-Point to point control, Continuous path control, Intelligent robot, Control system for robot joint, Control actions, Feedback devices, Encoder, Resolver, LVDT, Motion Interpolations, Adaptive control. Introduction to Robotic Programming, On-line and off-line programming, programming examples.

Robot applications- Industrial Applications of Robots for Material handling, Machine loading and unloading, assembly operation, Inspection, continuous arc welding, Spot welding, Spray painting, cleaning, robot for underwater applications etc.

SUGGESTED READING/ BOOKS:

1. Mikell P Groover, Nicholas G Odrey, Mitchel Weiss, Roger N Nagel, Ashish Dutta, “Industrial Robotics, Technology programming and Applications", McGraw Hill, 2012.
2. Craig. J. J. “Introduction to Robotics- mechanics and control”, Addison- Wesley, 1999. Reference Books:
3. S.R. Deb, “Robotics Technology and flexible automation”, Tata McGraw-Hill Education., 2009. 4. Richard D. Klafter, Thomas .A, ChriElewski, Michael Negin, "Robotics Engineering an Integrated Approach", PHI Learning., 2009.
5. Francis N. Nagy, Andras Siegler, "Engineering foundation of Robotics", Prentice Hall Inc., 1987.
6. P.A. Janaki Raman, "Robotics and Image Processing an Introduction", Tata McGraw Hill Publishing company Ltd., 1995.
7. Carl D. Crane and Joseph Duffy, "Kinematic Analysis of Robot manipulators", Cambridge University press, 2008.
8. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., “Robotics control, sensing, vision and intelligence”, McGraw Hill Book co, 1987
9. Ray Asfahl. C., “Robots and Manufacturing Automation”, John Wiley & Sons Inc.,1985

BTAR-504-18 DIGITAL ELECTRONICS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	0	0	3	40	60	100	3

Course Outcomes:

Students will be able to:

CO-1 Understand the different number systems and codes used to represent the digits and fundamental of arithmetic operation using each number system and codes.

CO-2 Understand the minimization of logic function.

CO-3 Design and analyze the various combinational circuits and sequential circuits.

CO-4 Apply the fundamental knowledge of analog and digital electronics to get different types of analog to digital signal and vice-versa converters.

CO-5 Learn about the different semiconductor memories.

Detailed Contents:

Unit I Number System and Binary Code: Introduction, Binary, Octal, Decimal and Hexadecimal Number Systems. Signed and unsigned numbers, Binary Subtractions using 1's and 2's compliment, ASCII code, Excess 3 code, Grey code, BCD code and BCD additions.

Unit II Minimization of logic function: OR, AND,NOT,NOR,NAND,EX-OR, EX-NOR, Basic theorem of Boolean Algebra, Sum of Products and Product of Sums, canonical form, Minimization using K-map and Q-M method.

Unit III Combinational Circuits: Introduction, Combinational circuit design, Encoders, Decoders, Adders, Subtractors and Code converters. Parity checker, Seven segment display, Magnitude comparators. Multiplexers, De-multiplexer, Implementation of Combinational circuit using MUX.

Unit IV Sequential Circuits: Introduction, Flip flops, Clocked flip flops, SR, JK, D, T and edge triggered flip-flops. Excitation tables of Flip flops. Shift Registers, Type of Shift Registers, Counter, Counter types, counter design with state equation and state diagrams.

Unit V D/A and A/D Converters: Introduction, Weighted register D/A converter, Binary ladder D/A converter, Steady state accuracy test, D/A accuracy and resolution, parallel A/D converter, Counter type A/D converter Successive approximation A/D converter. Single and dual slope A/D converter, A/D accuracy and resolution.

Unit VI Semiconductor Memories: Introduction, Memory organisation, Classification and characteristics of memories, Sequential memories, ROMs, R/W memories. Content addressable memories. PLA and PAL.

SUGGESTED READING/ BOOKS:

- R. P. Jain, *Modern Digital Electronics*, 3rd edition, Tata McGraw–Hill Publishing Company Limited, New Delhi,2003.
- Morris Mano, *Digital Design*, Prentice Hall of India Pvt. Ltd.
- Donald P. Leach and Albert Paul Malvino, *Digital Principles and Applications*, 5th edition, Tata McGraw Hill Publishing Company Limited, New Delhi,2003.
- Thomas L. Floyd, *Digital Fundamentals*, Pearson Education, Inc, New Delhi, 2003.
- Ronald J. Tocci, Neal S. Widmer, Gregory L. Moss, *Digital System -Principles and Applications*, Pearson Education.
- Srivastava, *Digital Design: HDL Based Approach*, Cengage Learning.
- Roth, *Fundamentals of Logic Design*, Cengage Learning.

BTAR-505-18 ELECTRONIC DEVICES AND DIGITAL CIRCUITS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

1. Implementation of half and full wave rectifier with C filter and (78XX) voltage regulator.
2. Implementation of full wave rectifier with C filter and voltage regulator (78xx)
3. Input and output characteristics of BJT and FET/MOSFETs.
4. Frequency response of BJT CE amplifier.
5. Opamp as Inverting and NonInverting Amplifier,
6. Opamp as Instrumentation amplifier, Schmitt Trigger/Wave Generating Circuits.
7. IC 555 Timer applications.
8. Study of ADC/DAC.
9. Realization of given Boolean expression using basic gates and universal gates.
10. Realization of adder and subtractor using logic gates.
11. Realization of 4:1 Mux, 1:4 Demux, 8 to 3 encoder, 3 to 8 decoder using ICs.
12. Shift left; shift right, SIPO, SISO, PISO, and PIPO operations using D Flip flop.
13. Realization of asynchronous and synchronous 3-bit counters.
14. Realization of decade counter and Mod-5 counter using 7490.

BTAR506-18 COMPUTER AIDED DESIGN AND MANUFACTURING LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

I. INTRODUCTION TO MODELING (USING ANY CAD SOFTWARE):

1. 2D drawing using sketcher – 2 Drawings
2. 3D modeling using 3D features (Modeling of Crane Hook, Bench Vice, Screw Jack components)
3. Assembling and drafting (any 2 above mentioned assemblies) with proper mating conditions and interference checking
4. Surface modeling – (Computer mouse, Plastic bottles with spraying Nozzle)

II. COMPUTER AIDED MANUFACTURING:

1. Manual part programming on CNC Lathe and CNC Milling – (4 programs, 2 for each)
2. Computer Aided Part programming for CNC Lathe and CNC Milling to generate tool path, NC code, and Optimization of tool path (to reduce machining time) using any CAM software.

BTAR507-18 DIGITAL ELECTRONICS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

List of experiments:

1. Study of Logic Gates: Truth-table verification of OR, AND, NOT, XOR, NAND and NOR gates; Realization of OR, AND, NOT and XOR functions using universal gates.
2. Realization Half Adder / Full Adder using Logic gates.
3. Realization Half Subtractor / Full Subtractor using Logic gates
4. Design 4-Bit Binary-to-Gray & Gray-to-Binary Code Converter.
5. Design 4-Bit magnitude comparator using logic gates. Multiplexer: Truth-table verification and realization of Half adder and Full adder using MUX.
6. Demultiplexer: Truth-table verification and realization of Half subtractor and Full subtractor using DEMUX.
7. Flip Flops: Truth-table verification of RS, JK , D, JK Master Slave Flip Flops.
8. Design MOD-7 Synchronous up-counter using JK/RS/D Flip Flops.
9. Shift Register: Study of shift right, SIPO, SISO, PIPO, PISO & Shift left operations using IC7495 chip.

BTAR-508-18 GERMAN/JAPANESE/FRENCH LANGUAGE LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
0	0	2	2	30	20	50	1

FRENCH SYLLABUS

Module 1

Rencontrer quelqu'un et faire connaisssnce; Saluer et prendre congé.
(Meet someone and get acquainted; Basic expressions to greet and take leave)

Module 2

Se présenter (prénom, âge, nationalité, lieu où l'on habite, les langues que l'on parle)
(Introduce oneself : Name, age, nationality, place where one lives, languages that one speaks)

Module 3

Les nombres jusqu'à 50.
(Numbers till 50)

Module 4

Les jours de la semaine
Les mois de l'année
(Names of days and months)

External Assessment: Viva-voce - 20 marks

1. Présentez-vous. (Introduce yourself) - 10 marks
2. Un jeu de rôle à partir de la thématique : les rencontres.(Dialogue simulation based on the theme : Meetings and greetings) - 5 marks
3. Lecture d'un texte simple d'environ 30 mots ou de 4-5 courtes phrases (Reading of a basic text of about 30 words in French or very short 4-5 sentences in French) - 5 marks

Text Books:

1. Christine Andant etal. ―A propos (livre de l eleve)‖, LANGERS, New Delhi, 2012

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GERMAN SYLLABUS

Objectives: The aim is to develop effective communication skill of the students with greater emphasis on oral communication so that they will be able to write and speak German Language most efficiently and effectively.

Course Contents:

Unit I Introduction to Sound system, Alphabets, Greetings, German culture, professions and various nationalities & Numbers 0-20.

Unit II Articles-Definite, Indefinite, Negative (Nominativ and Akkusativ cases), Vocabulary (nouns), Usage of Adjectives. Time related forms - Formal & informal expressions. Days of the week & Months of the year and Numbers 21-50
(Questions in the form of fill in the blanks should be asked from UNIT I & II combined)

Unit III Conjugation of verbs- Regular & Irregular in the present tense. Introduction of Dativ case and exercises based upon nominative, accusative and dative cases. Various seasons & Time; Numbers 51-100

Unit IV Simple dialogues- Preferably based on the following situations:
Reservation of air/train/bus tickets, hotel rooms, giving directions to a place, taking a phone call, ordering food, fixing an appointment, etc.

Unit V Comprehension of a small seen/unseen passage (passage should be informative) limited to the vocabulary in the presented textbook.

External Examination: 20 Marks

80 words paragraph on my friend, my family, my father or my teacher. Choice must be given at least 1 out of 3 topics. 10 marks

Questions pertaining to grammar done under the heading "internal examination" above. 5 marks.

Questions based upon "the days of the week", "months of the year", "seasons"

OR

Simple dialogue writing (purchasing of articles/to exchange pleasantries between friends or teacher/to ask ok the address or way). 5 marks.

Note:

SYNTAX will be taken care of by practicing Word order and sentence formation. Practice with mini-dialogues.

COMMUNICATION SKILLS will be taken care of by : Conversing in formal and informal situations, Dialogue writing and Telephone conversations.

For the purposes of PRACTICALS teacher is advised to train the students by using language lab for the improvement of listening and speaking skills as per his/her convenience.

Text Books:

Tangram Aktuell 1 (Deutsch als Fremdsprache) - Rosa-Maria Dallapiazza, Eduard von Jan, Til Schönherr - Max Hueber Verlag, 2004.

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JAPANESE SYLLABUS

Unit -1 Orientation Session, Geographic & Socio, economic perspective to Japan, Japanese people and culture and Basic greetings and responses.

Unit -2 Basic script, Method of writing hiragana and katakana, and Combination sounds and simple words.

Unit -3 Topic marker ―wa‖, Desu / dewa arimasen cupolas, Interrogative particle ―ka‖, Grammar particles ―mo‖, ―no‖, _‘ Introducing some one: ―Kochira wa ~― and Self introductions: Hajimemashite

Unit -4 Demonstratives ―Kore‖, ―Sore‖, ―Are‖, Demonstrative ―Kono‖, ―Sono‖, ―Ano‖, Possessive noun particle ―no‖ and Japanese apartments: Greeting your neighbour

Unit -5 Place marakers ―Koko‖, ―Soko‖, ―Asoko‖, Direction markers ―Kochira‖, ―Sochira‖, ―Achira‖ and Japanese department stores: Asking for and buying something.

Asking for and telling the time, Paticle ―ni (at)‖ for time, kara (from) ~ made (until), Particle ―to (and)‖, Time periods: Days of the week, months, time of day, Verbs (Present / future and past tense) and Telephone enquiry: Asking for a phone no. And business hours.

Destination particle ―e‖, Particles ―de (mode of transportation)‖ and ―to (with) and Japanese train station: Asking for Fare and track no. / types of trains

Text Books:

Minna no nohongo – Romaji ban (first 10 lessons of this book), 3A Corporation, Tokyo, 2000.

Semester Sixth (Contract Hours: 29 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR601-18	Power Electronics and Drives	3	1	0	4	40	60	100	4
BTAR602-18	Numerical Methods	3	1	0	4	40	60	100	4
BTAR603-18	Electronic Measurement and Instrumentation	4	0	0	4	40	60	100	4
BTAR604-18	Microprocessors and Microcontrollers	4	0	0	4	40	60	100	4
BTAR605-18	Introduction to Industrial Management	3	0	0	3	40	60	100	3
BTAR606-18	Microprocessors and Microcontrollers Lab	0	0	2	2	30	20	50	1
BTAR607-18	Electronic Measurement and Instrumentation Lab	0	0	2	2	30	20	50	1
BTAR608-18	Project -I (Project/Internship)	0	0	4	4 / 90hrs	30	20	50	2
BMPD601-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**29**	**290**	**360**	**650**	**23**

The project work will be carried out in parts as minor project in 6th semester and major project in 7/8th semester. The literature survey, problem formulation, assessment for viability of the project, objectives and methodology for the project shall be decided in 6th semester. The same project problem is to be extended in the major project in semester. The minor project may be carried out by a group of students 2 to 4.

BTAR601-18 POWER ELECTRONICS & DRIVES

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
3	1	0	4	40	60	100	4

Objectives:

1. To provide the knowledge of Thyristor family, its characteristics and operations with its commutation technique.
2. To provide the knowledge of different phase controlled technique and its applications.
3. To understand the principle of operations for Choppers, Cyclo converters and Inverters.

Detailed Contents:

1. Thyristors and their characteristics:

Introduction to thyristor family V-I characteristics of SCR, SUS, PUT, SCS, GTO, LASCR, DIAC and TRIAC, Principle of operation of SCR, Two transistor analogy, Turn on methods of a thyristor, Switching characteristics of thyristors during turn-on and turn-off, Gate characteristics, Firing of thyristors, Gate triggering circuits, Series and parallel, operation of SCRs and their triggering circuits, Thyristor specifications; such as latching current and bolding current, dv/dt and di/dt, PTV etc. Protection of SCR from over voltage and over current, Snubber circuits, Power dissipation.

2. Thyristor commutation Techniques:

Load commutation (Class A), Resonant-Pulse commutation (class B), impulse commutation (class D), Line commutation (class F).

3. Phase controlled Techniques:

Introduction to phase angle control, Single phase half wave controlled rectifiers, Single phase half controlled and full controlled bridge rectifiers, Three phase full controlled bridge rectifiers, Effect of resistive, inductive and resistive conductive loads. Basic circuit and principle of operation of Dual Converter, circulating current mode and non-circulating current mode of operation, Applications of rectifiers and dual converters to speed control of DC motor drives.

4. Choppers

Introduction and principle of chopper operations, Control strategies, two quadrant chopper, Four quadrant chopper, Regenerative chopper, Steady state time domain analysis of type A-chopper, voltage commutated chopper or classical Jones chopper.

5. Cyclo converters

Basic circuit and operation of single phase cyclo converter, Single phase bridge cyclo converter, Three phase to single phase to single phase cyclo converter, Advantages disadvantages of cyclo converters.

6. Inverters

Introduction to inverter, Operating principle and already state analysis of single phase, voltage source, bridge inverter. Modified Mcmurray half-bridge and full bridge inverter, Three phase bridge inverter, Voltage control (PWM control etc.) and reduction of harmonics in the inverter output voltage, Series inverter.

Course Outcomes:

1. Students will be able to describe the characteristic, operation and applications of regarding different types of Thyristor.
2. Students will be able to describe the working of controlled rectifiers with different phase controlled technique.
3. They will be able to describe the working principle of Choppers, Cyclo converters and Inverters.

Suggested Readings/Books:

1. P.S. Bimbhra, **Power Electronics**, Khanna Publishers.
2. M.D. Singh, K.B. Khanchandani, **Power Electronics**, Tata Mc Graw Hill Publishing company limited.
3. M.H. Rashid, **Power Electronics**, PHI.
4. P.C. Sen**, Power Electronics**, Tata Mc Graw Hill Publishing company limited.

BTAR602-18 NUMERICAL METHODS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
3	1	0	4	40	60	100	4

Course objectives:
This course deals with the basic concepts of mathematical statistics and numerical analysis. The objective of this course is to introduce these concepts and focus on application of these for handling the problems arising in science, engineering and technology.

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

1. Apply the concepts of mathematical statistics in modeling processes and decision making.
2. Apply the concepts of numerical methods for solving problems arising in science, engineering and technology.
3. Solve continuous problems numerically which are difficult to deal with analytically.

Detailed Contents:

Unit-I

Probability and Probability Distributions: Population, Sample space, Events, Random Variables; Definitions of probability, conditional Probability, expectation, Binomial, Poisson and Normal distributions.
Testing of Hypothesis: Types of Error, Power of a test, Goodness of a fit, Student t and Chi-Square tests.

Unit-II

Floating-Point Numbers: Floating-point representation, Rounding, Chopping, Error Analysis. Condition and instability.
Solution of Algebraic and Transcendental Equations: Errors in numerical computation, bisection method, Newton-Raphson's method and method of false position, System of nonlinear equations: Newton-Raphson's method.

Unit-III

Linear System of Equations: Gauss elimination method and Gauss Jordan method. Eigenvalue Problem: Power Method.
Interpolation: Interpolation with Unevenly Spaced Points: Lagrange Interpolation, Newton's Divided Difference Interpolation; Interpolation with Evenly Spaced Points: Newton's Forward Difference Interpolation Formula, Newton's Backward Difference Interpolation Formula, Spline interpolation

Unit-IV

Numerical Differentiation and Integration: Numerical differentiation: Newton's Forward Difference Formula, Newton's Backward Difference Formula, Newton's Divided Difference Formula; Numerical Integration: Trapezoidal rule, Simpson's 1/3-rule and Simpson's 3/8 rule.

Numerical solution of ordinary differential equations (ODEs):
Initial Value Problems of ODEs: Taylor series method, Euler's methods, Runge-Kutta methods and linear multi-step methods (Adams-Bashforth & Adams-Moulton).

Text/Reference Books:

1. Gupta S.C., Kapoor V.K. (2014), Fundamentals of Mathematical Statistics, Sultan Chand & Sons, Delhi.
2. Jain M. K., Iyengar S. R. K, Jain R. K. (2007), Numerical methods for Scientific and Engineering Computation, New Age International Publishers, New Delhi.
3. Sastry S. S. (2012), Introductory Methods of Numerical Analysis, Prentice Hall of India, Delhi.

BTAR603-18 ELECTRONIC MEASUREMENT AND INSTRUMENTATION

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To develop the student's knowledge about basic concepts and definitions in measurement.
2. To provide the student with knowledge of analog and digital Meters.
3. To describe the different AC, DC bridge configurations and their applications.
4. To provide the student with knowledge of different signal generators and waveform analyzers.
5. To provide the student with knowledge of different recorders, display devices and transducers.
6. To provide the student with knowledge of data transmission using telemetry.

Detailed Contents:

Unit I Fundamentals

Generalized instrumentation system – Units and Standards, Calibration Methods, Standards of measurements, Classification of errors, error analysis, Static Characteristics- Accuracy, Precision, sensitivity, linearity, resolution, hysteresis, threshold, input impedance, loading effects etc, Dynamic Characteristics.

Unit II Electronic Meters

Electronic Analog voltmeter: DC voltmeters-Choppers type-DC amplifier, solid state voltmeter, Differential voltmeter, peak responding voltmeter, True RMS voltmeter, calibration of DC voltmeters. Digital Voltmeter:- Introduction, Ramp Techniques, dual slope, integrating type DVM, Successive approximation type DVM, Resolution and sensitivity of digital meters, general specification of a DVM. CRO's study of various stages in brief, measurement of voltage, current phase and frequency, special purpose oscilloscope.

Unit III Measuring Instruments

Principle of operation of galvanometer, PMMC, Moving Iron instruments, Resistance measurements using Wheatstone bridge, Kelvin Double Bridge, Ohm meter, AC bridges: Maxwell bridge, Maxwell wein bridge, Hey's Bridge, Schering Bridge, Anderson Bridge, Campbell Bridge.

Unit IV Instrumentation for Generation and Analysis of Waveforms

Signal generators: Fixed and variable AF oscillators, AF sine and square wave generator,
Function generator: Square and pulse generator, Sweep generator, wave analyzer, harmonic distortion analyzer, spectrum analyzer, spectrum analysis.

Unit V Storage and Display Devices

Necessity of recorders, recording requirements, graphic recorders, strip chart recorders, magnetic tape recorders, digital tape recorders, Electronic indicating instruments, seven segment display, fourteen segmental display Nixie tube.

Unit VI Transducers and DATA Acquisition Systems

Strain gauge, LVDT, thermocouple, piezoelectric, crystal and photoelectric transducers and their applications, Data acquisition systems.

Unit VII Telemetry
Introduction, method of data transmission, types of telemetry systems and applications.

Course Outcomes:

1. Students will demonstrate knowledge of measuring various electrical parameters with accuracy, precision, resolution.
2. Students will learn about different analog and digital Meters.
3. Students will demonstrate the ability to use AC and DC bridges for relevant parameter measurement.
4. Student will learn to generate, analyze and record different types of signals.
5. Students will demonstrate an ability to record, convert and transmit a measured signal.

Suggested Books:

1. Element of Electronic Instrumentation & Measurement, by Carr, Pearson Education.
2. Electronic Measurements & Instrumentation, by Kishore, Pearson Education.
3. Electronic Instrumentation, by H.S. Kalsi, Tata McGraw Hill.
4. Applied Electronics Instrumentation and measurement by David Buchla, Wayne Melachlan.
5. Electronics Measurement and Instrumentation, by B.H and Cag J.M, Tata McGrawHill
6. A.K. Sawhney , Electrical and Electronic Measurements and Instrumentation, Dhanpat Rai
7. D Cooper , Electronic Instrumentation and Measurement Techniques.

BTAR604-18 MICROPROCESSORS AND MICROCONTROLLERS

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit points
4	0	0	4	40	60	100	4

Objectives:

1. To develop the knowledge of internal organization, addressing modes and instruction sets of 8085 processors.
2. To develop the knowledge of various functional units of 8051 microcontrollers.
3. To understand assembly language program by using 8051 Instruction sets.
4. To develop the knowledge of interfacing different devices with 8051.

Detailed Contents:

Unit 1: Microprocessor 8085

History of microprocessors; microprocessor 8085 Architecture, Pin configuration; Memory Interfacing; microprocessor programming model; 8085 instructions; Addressing modes; programming techniques, counters and time delays; stack and subroutines; interrupts.

Unit 2: Microcontroller 8051 - Building Blocks

Microprocessor vs microcontroller; RISC vs CISC architectures; microcontroller 8051: architecture, pin configuration, flag-bits and PSW register, input-output ports, register banks and stack; semiconductor memories: ROM, SRAM, DRAM, virtual memory, cache memory; memory organization.

Unit 3: Microcontroller 8051 - Programming

Assembly language programming; data types and directives; jump loop and call instructions; I/O port programming; addressing modes and accessing memory using various addressing modes; arithmetic instructions and programs; logic instructions and programs; single bit instructions and programming, 8051 interrupts; timer/counter programming in the 8051.

Unit 4: Microcontroller 8051 - Interfacing

Parallel and serial ADC& DAC interfacing; LCD interfacing, Keyboard interfacing; sensor interfacing; interfacing with external memory; matrix keypad; stepper motor interfacing; DC motor interfacing and PWM.

Course Outcomes:

At the end of this course student will demonstrate the ability to:

1. Understand architecture & functionalities of different building block of 8085 microprocessor.
2. Understand working of different building blocks of 8051 microcontroller.
3. Comprehend and apply programming aspects of 8051 microcontroller.
4. Interface & interact with different peripherals and devices.

Suggested Books:

1. R S Gaonkar, **Microprocessor Architecture, Programming and Application with 8085**, Penram International Publishing Pvt. Ltd.
2. Douglas Hall, **Microprocessors Interfacing**, Tata McGraw Hill
3. Subrata Ghoshal, **8051 Microcontroller: Internals, Instructions, Programming and Interfacing**, Pearson Education
4. Kenneth Ayala, **The 8051 Microcontroller**, Cengage Learning
5. Krishna Kant, "**Microprocessors and Microcontrollers**" PHI Learning.

BTAR605-18 INTRODUCTION TO INDUSTRIAL MANAGEMENT

Course objectives:

- To help the students gain understanding of the functions and responsibilities of industrial managements.
- To enable them to analyze and understand the environment of the organization.
- To help the students to develop cognizance of the importance of management principles.
- To provide them tools and techniques to be used in the performance of the managerial job.

Detailed Contents:

Unit-1: Concept of industrial engineering, Roles of industrial engineer, Tools of management science, Introduction to quality, Excellence in manufacturing, Excellence in service, factors of excellence, relevance of total quality management.
Unit-II: Concept of production, Production system, Input output model, definition of quality, Total quality control and Total Quality Management, salient features of total quality control and total quality management, benefits of total quality management.
Unit-III: Introduction to product design, Effect of design on cost, Requirements of a good product design, Factors affect product design, Product life cycle, Need and concept of product planning, Concept of product development. Introduction of industrial cost, Elements of cost, Breakeven analysis.
Unit-IV: Materials management, Purchasing, Objectives of purchasing, Activities, duties and functions of purchasing department, Purchase organizations, Buying techniques, Purchasing procedure.
Unit-V: Concept of plant maintenance, Objectives and importance of plant maintenance, Duties, functions and responsibilities of plant maintenance department, Organization of maintenance, Scheduled, preventive and predictive maintenance.
Unit-VI: Inventory, Inventory control, Objectives of inventory control, ABC analysis, Just-in-time (JIT), Definition: Elements, benefits, equipment layout for JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
Unit-VII: Benchmarking: Meaning of benchmarking and its concept, Definition of benchmarking, Benefits of bench marking, process and types of benchmarking.

Unit-VIII: Customer: Types of customers, Customer satisfaction, Role of marketing, Data collection, Customer complaints, Redressal mechanism.

Course Outcomes:

- Understand the complexities associated with management in the organizations and integrate the learning in handling these complexities.
- Demonstrate the roles, skills and functions of management.
- Understand the concepts related to industrial management.

Text Books:

1. Industrial Engineering and Management/ O. P. Khanna/ Dhanpat Rai and Sons
2. General and Industrial Management/ H Fayol/ Pitman
3. Industrial Management/ I. K. Chopde and A. M. Sheikh/ S. Chand
4. A Text Book of Industrial Management/ A. P. Verma and N. Mohan/ Katson
5. Total Quality Management/ Jeol E. Ross/ Taylor and Francis Limited.

BTAR 606-18 MICROPROCESSORS AND MICROCONTROLLERS LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
0	0	2	2	30	20	50	1

Objectives:

This is laboratory course meant to write programs using 8085/8086 microprocessor and learn interfacing using 8051 microcontroller for general operations.

Course Outcomes

At the end of this Lab course student will be able to:

1. Write programs for common arithmetic operations with 8-bit/16-bit numbers using 8085.
2. Write programs for transfer, sort block of data with 8085/8086 processor(s).
3. Write programs for controlling stepper and DC motors using Microprocessor(s).
4. Write programs to generate waveforms and interface ADC and DAC using of 8051 Microcontroller.

Part-A: Write programs in Assembly language & embedded C to

1. Add two 8-bit numbers stored in registers or internal/External memory locations.
2. Multiply two 8-bit numbers.
3. Multiply two 16-bit numbers.
4. Transfer block of data from internal memory locations to external memory locations
5. Sort block of data in ascending or descending order.
6. Generate 5KHz pulse waveform of 50% duty cycle.
7. Interface ADC and DAC.
8. Interface Matrix Keyboard.
9. Interface LCD Displays.
10. Interface Stepper Motor.
11. Control DC motor using PWM.

Part-B: Lab Projects

Every individual student is required design one Lab Project under the supervision of course teacher. Topic of the project may be any from the theory contents and not limited to following list:

1. RFID attendance system
2. Home automation
3. Robotic vehicle
4. Sensor traffic lights
5. Floor cleaning robot
6. Robot for defense applications
7. GPS vehicle tracking
8. Accident identification and SMS

BTAR 607-18 ELECTRONIC MEASUREMENT & INSTRUMENTATION LAB

L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
0	0	2	2	30	20	50	1

List of Experiments:

1. Measurement of Inductance by Maxwell's Bridge.
2. Measurement of small resistance by Kelvin's Bridge.
3. Measurement of Capacitance by Schering Bridge.
4. Measurement of Frequency by Wein Bridge.
5. Measurement of medium resistance by Wheat Stone's Bridge.
6. Determination of frequency & phase angle using C.R.O.
7. To find the Q of a coil using LCR-Q meter.
8. To determine output characteristic of a LVDT and determine its sensitivity.
9. Study characteristics of temperature transducer like Thermocouple, Thermistor and RTD with implementation of small project using signal conditioning circuit.
10. Study characteristics of Light transducer like Photovoltaic cell, Phototransistor and Pin Photodiode with implementation of small project using signal conditioning circuit.
11. To study input- output characteristics of a potentiometer and to use two potentiometers as an error detector.
12. To study transmitter- receiver characteristics of a synchro set to use the set as control component.
13. To study the operation of a d-c positional servo system and to investigate the effect of damping and supply voltage on its response.
14. To study the operation of an a.c. position servo-system and to obtain effects of supply voltage and system parameter on its transient response.
15. To study a stepper motor and control its direction speed and number of steps with the help of a microprocessor.

Semester Seventh /Eighth (Contract Hours: 30 Hours)

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR701-18	Control Systems	4	0	0	4	40	60	100	4
BTAR 702-18	Programming Industrial Automation systems	4	0	0	4	40	60	100	4
Elective -I		3	1	0	4	40	60	100	4
Elective-II		3	0	0	3	40	60	100	3
BTAR703-18	Advanced Robotics	3	0	0	3	40	60	100	3
BTAR704-18	Advanced Robotics	0	0	2	2	30	20	50	1
BTAR705-18	Major Project	0	0	8	8	30	20	50	4
BMPD701-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**260**	**340**	**600**	**23**

List of Subjects (Elective- I)

S. No	Subject Code	Subject Name	Credits
1	**BTAR706-18**	Communication System	4
2	**BTAR707-18**	Sensors & Signal Processing	4
3	**BTAR708-18**	Micro-controller and PLC	4
4	**BTAR709-18**	Mechanical Vibration	4
5.	**BTAR710-18**	Electromechanically Energy Conversion and DC Machines	4

List of Subjects (Elective- II)

S. No	Subject Code	Subject Name	Credits
1	**BTAR711-18**	Linear Integrated Circuits	3
2	**BTAR712-18**	Human Resources Management	3
3	**BTAR713-18**	Total Quality Management	3
4.	**BTAR714-18**	Non-Conventional Energy Resources	3

Semester Seventh /Eighth

Code	Course Title	Evaluation Internal (Maximum Marks)		External (Maximum Marks)	Total Marks	Credit Points
		Institute	Industry			
BTAR-801-18	**Software**	100	50	100	250	8
	Industrial	100	50	100	250	8
	Total	200	100	200	500	16

BTAR701-18	Credits	L	T	P	Int	Ext
CONTROL SYSTEMS	4	4	0	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to

1. Characterize a system and find its steady state behavior.
2. Investigate stability of a system using different tests.
3. Design various controllers.
4. Solve linear, non-linear and optimal control problems.

Unit 1: Introduction

Classification with understanding of Industrial Control system examples. Transfer function. System with dead-time. System response. Control hardware and their models: potentiometers, synchros, LVDT, DC and AC servomotors, Tacho generators, Electro hydraulic valves, hydraulic servomotors, electro pneumatic valves, pneumatic actuators. Closed-loop systems. Block diagram and signal flow graph analysis.

Unit 2: Feedback Control systems

Stability, steady-state accuracy, transient accuracy, disturbance rejection, insensitivity and robustness. proportional, integral and derivative systems. Feed forward and multi-loop control configurations, stability concept, relative stability, Routh stability criterion.

Unit 3: Second Order systems

Time response of second-order systems, steady-state errors and error constants. Performance specifications in time- domain. Root locus method of design. Lead and lag compensation. Frequency-response analysis- Polar plots, Bode plot, stability in frequency domain, Nyquist plots. Nyquist stability criterion. Performance specifications in frequency- domain. Frequency domain methods of design, Compensation & their realization in time & frequency domain. Lead and Lag compensation. Op-amp based and digital implementation of compensators. Tuning of process controllers. State variable formulation and solution.

Unit 4: State variable Analysis

Concepts of state, state variable, state model, state models for linear continuous time functions, diagonalization of transfer function, solution of state equations, concept of controllability & observability. Introduction to Optimal control & Nonlinear control, Optimal Control problem, Regulator problem, Output regulator, tracking problem. Nonlinear system – Basic concept & analysis.

Recommended Books:

- Gopal. M., “Control Systems: Principles and Design”, Tata McGraw-Hill, 1997.
- Kuo, B.C., “Automatic Control System”, Prentice Hall, sixth edition, 1993.
- Ogata, K., “ Modern Control Engineering” , Prentice Hall, second edition, 1991.
- Nagrath & Gopal, “Modern Control Engineering”, New Age International, New Delhi

BTAR 702-18	Credits	L	T	P	Int	Ext
PROGRAMMING INDUSTRIAL AUTOMATION SYSTEMS	4	4	0	0	40	60

Course Outcomes

At the end of this course:

CO1. Student will understand the different types of Industrial Process & Process Control Philosophies.

CO2. Student will learn the basics of Programmable Logic Controller.

CO3. Student will learn about the designing of ladder diagram from process control descriptions by using different PLC functions.

CO4. Student will learn about the PLC arithmetic and logical functions & Data Handling functions.

1. Nature of Industrial Process: continuous & discrete state sequential process, process variables and their classification.

2. Introduction to Process Control Philosophies: type of relays, ladder logic methodology, ladder symbols.

3. Introduction to Programmable Logic Controllers: advantages & disadvantages of PLC with respect to relay logic, PLC architecture, Input Output modules, PLC interfacing with plant, memory structure of PLC.

4. PLC programming methodologies: ladder diagram, STL, functional block diagram, creating ladder diagram from process control descriptions, introduction to IEC61131 international standard for PLC.

5.PLC functions: bit logic instructions, ladder diagram examples, interlocking, latching, inter dependency and logical functions, PLC Timer & Counter functions on-delay timer, off-delay timers, retentive on-delay timers, pulse timers, timer examples, up-counter, down-counter and up-down counter, counter examples, register basics.

6. PLC Data Handling: data move instructions, table and register moves, PLC FIFO & LIFO functions**.**

7. PLC arithmetic and logical functions: addition, subtraction, multiplication, division instructions, increment decrement, trigonometric and log functions, AND, OR, XOR, NOT functions, PLC compare and convert functions.

Suggested Books:

1. John Webb, Programmable Logic Controllers Principles & applications, PHI

2. T. A. Hughes, Programmable Controllers

3. C. D. Johnson, Process Control Instrumentation

BTAR703-18	Credits	L	T	P	Int	Ext
ADVANCED ROBOTICS	3	3	0	3	40	60

Course Outcome

At the end of this course:

CO1. Student will able to use matrix algebra for computing the kinematics of robots.

CO2. Student will able to calculate the forward kinematics and inverse kinematics of serial and parallel robots.

CO3. Student will able to calculate the Jacobian for serial and parallel robot.

CO4. Student will able to do the path planning for a robotic system.

1. Robot Coordinate System

Position and orientation of objects, Object coordinate frames, Rotations matrix, Euler angles , Roll pitch and yaw angles coordinate, Transformations, Joint variables and position of end effecter, Dot and Cross products, coordinates frames, Rotations, Homogeneous coordinates.

2. Forward Kinematic

Introduction to Forward kinematic, Denavit-Hartenberg (D-H) representation (with examples), The arm equation, the arm matrix of serial link manipulators, forward/direct kinematic analysis for serial link manipulators.

3. Inverse Kinematic

Introduction to inverse kinematics, General properties of inverse kinematic solution, Tool configuration vector, Tool configuration of serial link manipulators with examples of five axis. Articulated robot and four-axis SCARA Robot. Inverse kinematics of a serial link manipulator.

4. Velocity and Static Analysis of robotic manipulators

Linear and angular velocity of links, Velocity propagation, Manipulator Jacobians for serial and parallel manipulators, Velocity ellipse and ellipsoids, Singularity analysis for serial and parallel manipulators, Loss and gain of degree of freedom, Statics of serial manipulators, work space analysis of serial link manipulators

5. Dynamics of serial manipulators

Mass and inertial of links, Lagrangian formulation for equations of motion for serial manipulators, Kinetic and potential energy, Lagrangian-Euller dynamic mode., Direct and inverse dynamics, Recursive dynamics using Newton-Euler formulation

6. Motion Planning and Control

Joint and Cartesian space trajectory planning and generation, Classical control concepts using the example of control of a single link, Independent joint PID control, Control of a multi-link manipulator, Nonlinear model based control schemes.

7. Robot programming

On line programming, teach pendant control, Lead through programming, Walk through programming, off line programming, Task programming.

Suggested Books:

1. Schilling, R. J., Fundamentals of Robotics Analysis & Control, Prentice Hall of India

2. Fu, K. S., Gonzalez, R. C. and Lee, C. S., Robotics: Control, Sensing, Vision, and Intelligence, McGraw Hill

3. Craig, J. J., Introduction to Robotics: Mechanics and Control, Pearson Education

4. Deb, S. R., Robotics and Flexible Automation, McGraw Hill.

5. Saha, S. K., Introduction to Robotics, McGraw Hill

BTAR-704-18	Credits	L	T	P	Int	Ext
ADVANCED ROBOTICS LAB	**2**	**0**	**0**	**2**	**30**	**20**

List of Experiments

1. Study of different actuators and end effector for robot.
2. Robot Programming with Computer Simulation Software.
3. Programming of robots by manual, lead through and off-line methods, use of robot programming languages to pick and place, stacking of objects in increasing or decreasing size, palletizing operations, assembly and inspection operation etc.
4. Solving Robot Arm Kinematics with **MATLAB**
   a) Matrix multiplication and Concatenation of matrices in matlab, inverse of a matrix
      To solve different transformation matrices, to find the homogeneous transformation matrix of robotic manipulator, to find the joint angles when the end effector position is given.
   b) Robot workspace: Plot of end effector position vector in three-dimensional space.

BTAR706-18	Credits	L	T	P	Int	Ext
COMMUNICATION SYSTEM	4	3	1	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Analyze and compare different analog modulation schemes for their efficiency and bandwidth
2. Analyze the behavior of a communication system in presence of noise
3. Investigate pulsed modulation system and analyze their system performance
4. Analyze different digital modulation schemes and can compute the bit error performance

Unit 1: Analog Communication

Review of Signals and Systems, Frequency domain representation of signals, Amplitude Modulation: Transmission and Reception of DSB, SSB and VSB,Angle Modulation, Spectral characteristics of angle modulated signals, Principles of Frequency and Pulse Modulation, Representation of FM and PM signals, Review of white noise characteristics, Noise in amplitude modulation and Angle Modulation systems, Pre-emphasis and De-emphasis.

Unit 2: Digital Communication

Analog to Digital: Need, Sampling process, Pulse Amplitude modulation and Concept of Time division multiplexing, Pulse code modulation (PCM), Differential pulse code modulation. Delta modulation and demodulation, Adaptive and Sigma Delta Modulation, Noise considerations in PCM, Digital Multiplexers.

Unit 3: Elements of Detection Theory

Optimum detection of signals in noise, Coherent communication with waveforms- Probability of Error evaluations. Review of probability and random process Gaussian noise characteristics, Baseband Pulse Transmission: Inter symbol Interference and Nyquist criterion.

Unit 4: Digital Modulation Techniques

Phase Shift Keying, Frequency Shift Keying, Quadrature Amplitude Modulation, Continuous Phase Modulation and Minimum Shift Keying.

Recommended Books

1. Haykin S., "Communications Systems", John Wiley and Sons, 2001.
2. Proakis J. G. and Salehi M., "Communication Systems Engineering", Pearson Education, 2002.
3. Taub H. and Schilling D.L., "Principles of Communication Systems", Tata McGraw Hill, 2001.
4. Wozencraft J. M. and Jacobs I. M., ``Principles of Communication Engineering",John Wiley, 1965.
5. Barry J. R., Lee E. A. and Messerschmitt D. G., ``Digital Communication", Kluwer Academic Publishers, 2004.
6. Proakis J.G., ``Digital Communications", 4th Edition, McGraw Hill, 2000.

BTAR707-18	Credits	L	T	P	Int	Ext
SENSORS AND SIGNAL PROCESSING	4	3	1	0	40	60

Course Outcomes

At the end of this course:

1. Student will learn the working of different smart sensors and their applications.
2. Student will learn the introduction about signal conditioning, signal processing and data acquisition.
3. Student will learn the designing of digital filters.
4. Student will learn the introduction about PID controllers.

1. Smart Sensors

Radiation Sensors - Smart Sensors - Film sensor, MEMS & Nano Sensors – applications -Automobile, Aerospace, Home appliances, Manufacturing, Medical diagnostics, Environmental monitoring.

2. Signal Conditioning And Data Acquisition

Amplification – Filtering – Sample and Hold circuits –Data Acquisition: Single channel and multichannel data acquisition – Data logging.

3. Signal Processing

Introduction, Z-Transform, Region of convergence; Inverse Z Transform methods, properties of Z transform.

4. Design of Digital Filters

Structures of realization of discrete time system, direct form, Cascade form, parallel form and lattice structure of FIR and IIR systems. Linear Phase FIR filters; Design methods for FIR filters; IIR filter design by Impulse Invariance, Bilinear Transformation, Matched Z-Transformation, Analog and Digital Transformation in the Frequency Domain. Finite Precision Effects**:** Fixed point and Floating point representations

5. PID Controller

Process Control, Introduction to Process Control, P-I-D Control, Controller Tuning, Implementation of P-I-D Controllers.

Suggested Books:

- E. O. Doebelin, Measurement Systems – Applications and Design , Tata McGraw Hill, edition 1992.
- A. K. Sawhney, A course in Electrical and Electronic Measurement and Instrumentation, Dhanpat Rai and Co (P) Ltd, 2004.
- Beckwith, Marangoni and Lienhard, Mechanical Measurements, Addison – Wesley, 5th Edition, 2000.
- D. Roy Choudry, Sheil Jain, Linear Integrated Circuits, New Age International Pvt. Ltd., 2000.
- Patranabis. D, Sensors and Transducers, 2nd edition PHI, New Delhi, 2003.

BTAR708-18	Credits	L	T	P	Int	Ext
MICROCONTROLLER AND PLC	4	3	1	0	40	60

Course Outcomes

At the end of this course:

1. Student will learn the introduction about 8051.
2. Student will learn the assembly language programming of 8051.
3. Student will learn the 8051 microcontroller design and its applications.
4. Student will learn the introduction about Programmable Logic Controllers (PLC).

1. **Introduction**
   Microprocessor, Microcontrollers and their comparison. The 8051 Architecture: Introduction, 8051 microcontroller hardware, input/ output, pins, ports and circuits, external memory, counters and timers, serial data input/ output, interrupts.
2. **8051 Assembly Language Programming**
   The mechanics of programming, assembly language programming process, programming tools and techniques, instruction set (data moving, logical operations, arithmetic operations, jump and call instructions)
3. **8051 Microcontroller Design**
   Microcontroller specification, external memory and memory space decoding, reset and clock circuits, expanding input and output (I/O), memory mapped I/O, memory address decoding, memory access times, testing the design, timing subroutines, lookup tables for the 8051, serial data transmission
4. **Microcontroller Applications**
   Interfacing keyboards, displays, Digital-to-Analog (D/A) and Analog-to-Digital (A/D), multiple interrupts, serial data communications, introduction to the use of assemblers and simulators Embedded Systems: Introduction to PLDs and FPGA- architecture, technology and design issues, implementation of 8051 core.
5. **Programmable Logic Controllers (PLC)**
   Introduction, operation of PLC, difference between PLC and Hardwired system, difference between PLC and Computer, relay logic and ladder logic, ladder commands and examples of PLC ladder diagram realization, PLC timers, PLC counters, PLC classification.

Suggested Books:

1. Kenneth J Ayola, The 8051 Micro Controller -Architecture, Programming and Application , Penram International Publication
2. John B Peatman, Design with Micro Controller, Tata McGraw Hill
3. Ray A.K and Bhurchand K.M., Advanced Microprocessors and Peripherals; Architecture, Programming and Interfacing , Tata McGraw Hill
4. Mazidi M.A. and Mazidi J.G., The 8051 Micro-controller and Embedded System, Pearson Education.
5. Udayashank ara V. and Mallikarjunaswamy M.S., 8051 Micro controller Hardware, Software and Applications , TataMcGraw Hill Education Pvt. Ltd., (2010)

BTAR709-18	Credits	L	T	P	Int	Ext
MECHANICAL VIBRATIONS	4	3	1	0	40	60

Course Outcomes

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

CO1: Formulate mathematical models of problems in vibrations using Newton's second law or energy principles

CO2: Understand the need and measurement of vibration in mechanical systems

CO3: Calculate principal modes of vibration

CO4: Explore the suitable methods of vibration reduction and absorption

CO5: Ability to determine vibratory responses of SDOF and MDOF systems

CO6: Create the mathematical model of a vibratory system to determine its response

UNIT - I Introduction, Classification of Vibration Systems, Harmonic motion, Vector re[presentation of harmonic motion, Natural frequency & response, Effects of vibration, superposition of simple harmonic motions, beats, Fourier analysis-analytical and numerical methods. Single Degree Freedom System, Equation of motion, Newton's method, D'Alembert's principle, Energy method etc., Free vibration, Natural frequency, Equivalent systems, Displacement, Velocity and acceleration, Response to an initial disturbance, Torsional vibrations, Damped vibrations, Vibrations of systems with viscous damping, Logarithmic decrement, Energy dissipation in viscous damping.

UNIT - II Single Degree Freedom: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments.

UNIT- III Two Degree Freedom systems Introduction, Principal modes, Double pendulum, Torsional system with damping, Coupled system, Principle of vibration absorber, Undamped dynamic vibration absorbers, Torsional vibration absorber, Centrifugal pendulum absorbers, Vibration isolators and Dampers.

UNIT- IV Multi-degree Freedom system: Exact Analysis, Undamped free and forced vibrations of multi-degree freedom systems, influence coefficients, Reciprocal theorem, Torsional vibration of multi-degree rotor system, Vibration of gear system, Principal coordinates, Continuous systems- Longitudinal vibrations of bars, Torsional vibrations of circular shafts.

UNIT- V Multi Degree Freedom system: Numerical Analysis by Rayleigh's method, Dunkerely's, Holzer's and Stodola methods, Rayleigh-Ritz method 5 Critical speed of shafts, Whirling of uniform shaft, Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed.

Books and References:

1. Mechanical Vibrations – G. K. Groover, Jain Brothers, Roorkee.
2. Mechanical Vibrations-Theory & Practice, S Bhave, Pearson Education.
3. Mechanical Vibrations-N K Grover, PBS Publications.
4. Theory of Vibrations with Applications, Thomson & Dahleh, Pearson Education.
5. Elements of Vibration Analysis, L Meirovitch, McGraw-Hill Education.
6. Mechanical Vibrations – Tse, Morse & Hinkle
7. Mechanical Vibrations – V. Rama Murthy, Narosa Publications 8. Mechanical Vibrations – D. Nag, Wiley

BTAR710-18	Credits	L	T	P	Int	Ext
ELECTROMECHANICALLY ENERGY CONVERSION AND DC MACHINES	4	3	1	0	40	60

Course Outcomes

At the end of this course:

1. Student will learn the basics of Electro-Mechanical Energy Conversion.
2. Student will learn about the working and construction of electrical machines.
3. Student will learn about the working and construction of different D.C machines.
4. Student will learn about the principle of working and construction of Cross-Field Machines with its application.

1. Electro-Mechanical Energy Conversion

Energy stored in electric and magnetic fields, energy conversion in singly and multiple excited systems, reluctance torque, reluctance and hystersis motors.

2. General Description of Electrical Machines

Description of electric circuits in cylindrical rotor and salient pole machines, MMF of Single and multiple coils, harmonic analysis of induced voltages and armature MMF, Effect of slots, winding factors, Torque in terms of flux and mmf.

3. D.C. Machines

Armature windings, single and double layers, windings & winding diagrams, E.M.F. and torque equations, interaction of fields produced by excitation circuit and armature, effect of brush shift, compensating winding, commutation, causes of bad commutation, methods of improving commutation, methods of excitation of d.c. generators and their characteristics. D.C. motors: characteristics, starting of shunt and series motor, starters, speed control methods-field and armature control, Ward Leonard method, Braking: plugging, dynamic and regenerative braking, Testing: Swinburn's test, Hopkinson test, Field test. Estimation of losses and efficiency.

4. Cross-Field Machines

Principle of working, analysis of cross-field generator, typical characteristics with different compensations. Applications.

Reference Books:

- Fitzgerald Kingsley & Kusko, Electric Machinery, Tata McGraw-Hill
- Langsdorff , Principles of D.C. machines, Tata McGraw-Hill
- Nagrath & Kothari , Electrical Machines, Tata McGraw-Hill Education, Jun 1, 2004
- P.S. Bhimbhra , Electrical Machinery, Khanna Publishers

BTAR711-18	Credits	L	T	P	Int	Ext
LINEAR INTEGRATED CIRCUITS	3	3	0	0	40	60

Course Outcomes

At the end of this course students will demonstrate the ability to:

1. Understand Differential and Cascade Amplifiers
2. Know the basics, working and characteristics of Op-Amps
3. Investigate various applications of Op-amps
4. Understand some specialized Op-Amps
5. Interpretation of Data Sheets and their Applications thereof.

UNIT I: DIFFERENTIAL ANDCASCADE AMPLIFIERS

Introduction: Differential Amplifier, its Circuit Configuration, Dual Input-Balanced output Differential amplifier, Dual Input Unbalanced output, Single Input Balanced & Unbalanced Output Differential Amplifier, Amplifier with their DC and AC analysis, Differential Amplifier with Swaping resistors, Constant current bias, Current Mirror, Cascaded differential amplifier stages, Level Translator, CE-CB Configuration.

UNIT II: INTRODUCTION TO OPERATIONAL AMPLIFIERS

Block diagram of a typical Op-Amp, Schematic symbol, integrated circuits and their types, IC package types, Pin Identification and temperature range, Interpretation of Data sheets, Overview of typical set of data sheets, Characteristics and performance parameters of and Op-Amp, Ideal Op-Amp, Equivalent circuit of an Op-Amp, Ideal voltage transfer curve, Open loop configurations: Differential, Inverting & Non Inverting. Practical Op-Amp: Input offset voltage, Input bias current, Input offset current, total output offset voltage, Thermal drift, Effect of variation in power supply voltages on offset voltage, Temperature and supply voltage sensitive parameters, Noise, Common Mode configuration and common mode rejection Ratio. Feedback configurations.

UNIT III: APLICATIONS OF OP-AMP

DC and AC amplifiers, Peaking Amp, Summing, Scaling and Averaging Amp, Instrumentation Amplifier, Log and Antilog Amp, Integrator, Differentiator. Active filters: First order LP Butterworth filter, Second order LP Butterworth filter, First order HP Butterworth filter, Second-order HP Butterworth filter, Higher order filters, Band Pass filter, Band reject Filter, All Pass filter, Phase shift Oscillator, Wein Bridge Oscillator, Square wave Oscillator, Basic Comparator, Schmitt trigger, V to F and F to V converters.

UNIT IV: SPECIALIZED IC APPLICATIONS

IC 555 Timer: Pin configuration, Block diagram, application of IC 555 as Monostable and
Astable .Multivibrator., Phase Lock Loops: Operating principles & applications of IC 565 and IC 566,Monolithic PLL TL082, Voltage Regulators: Fixed voltage regulators (78XX and 79XX), Adjustable voltage regulators (LM327), Analog multiplier ICs (MPY634 KP) and their applications, Switching Regulators, Audio Power amplifier, Video Amplifier, Isolation Amplifier, Opto-couplers and fibre optic IC.

Recommended Books

1. 1. Op Amps & Linear Integrated circuits by Ramakant A. Gayakwad, Pearson
2. Operational Amplifiers & Linear Integrated circuits by Robert F. Coughlin, Prentice Hall
3. Design with Operational Amplifiers and Analog Integrated Circuits, Sergio Franco, TMH.

BTAR712-18	Credits	L	T	P	Int	Ext
HUMAN RESOURCES MANAGEMENT	3	3	0	0	40	60

Course Outcome

At the end of this course:

CO 1. Students will learn and understand the meaning, nature and scope of Human Resource Management.

CO2. Students will understand the basics of recruitment and selection process.

CO3. Students will understand the concept of Training and Development and Job analysis.

CO4. Students will understand the concept of Job analysis, design and satisfaction.

CO5. Students will understand the human relation and Industrial relation.

Unit-I Introduction to Human Resource

Definition, Role and Functions of Human Resource Management, Concept and Significance of HR, Changing role of HR managers, HR functions and Global Environment, role of a HR Manager.

Unit-II Human Resources Planning

Need and Process for Human Resource Planning, Methods of Recruitment, Planning Process, Planning at different levels, Recruitment and selection processes, Sources of Recruitment, Restructuring strategies, Placement and Induction, Retention of Employees, , Employment Exchanges (Compulsory Notification of vacancies).

Unit-III Training and Development

Principles of Training, Employee Development, Need for skill up gradation, Assessment of training needs, Retraining and Redeployment methods and techniques of training employees and executives, performance appraisal systems Career Development & Planning.

Unit-IV Job analysis, Design and Satisfaction

Job Analysis: Job Description & Job Description, Job Specification, Job satisfaction and its importance; Motivation, Factors affecting motivation, introduction to Motivation Theory; Workers ' Participation, Quality of work life.

Unit-V Industrial Relations

Factors influencing industrial relations, State Interventions and Legal Framework, Role of Trade unions, Collective Bargaining, Worker's participation in management.

Reference Books:

- T.N.Chhabra- Human Resource Management (Dhanpat Rai & Co.).
- Gary Dessler, Human Resource Management (8th ed.), Pearson Education, Delhi
- Biswajeet Patanayak, Human Resource Management, PHI, New Delhi
- A Minappa and M. S. Saiyada - Personnel Management (Tata Mc. Graw-Hill)

BTAR713-18	Credits	L	T	P	Int	Ext
TOTAL QUALITY MANAGEMENT	**3**	**3**	**0**	**0**	**40**	**60**

Course Outcomes

At the end of this course:

CO1: Understand quality concepts and philosophies of TQM.
CO2: Apply TQM principles and concepts of continuous improvement.
CO3: Apply and analyze the quality tools, management tools and statistical fundamentals to improve quality.
CO4: Understand & remember the quality systems and procedures adopted.

1. **Quality and Total Quality Management:** Excellence in manufacturing/service, factors of excellence, relevance of TQM.
2. **Concept and definition of quality:** Total quality control (TQC) and Total Quality Management (TQM), salient features of TQC and TQM. Total Quality Management Models, benefits of TQM.
3. **Just-in-time (JIT):** Definition: Elements, benefits, equipment layout for JIT system, Kanban system MRP (Material Requirement planning) vs JIT system, Waste elimination, workers involvement through JIT: JIT cause and effect chain, JIT implementation.
4. **Customer:** Satisfaction, data collection and complaint, redressal mechanism.
5. **Planning Process:** Policy development and implementation; plan formulation and implementation.
6. **Process Management:** Factors affecting process management, Quality function development (QFD), and quality assurance system.
7. **Total Employees Involvement (TEI):** Empowering employees: team building; quality circles; reward and Recognition; education and training, Suggestion schemes.
8. **Problems solving:** Defining problem, Problem identification and solving process, QC tools.
9. **Benchmarking:** Definition, concept, process and types of benchmarking
10. **Quality Systems:** Concept of quality system standards: relevance and origin of ISO 9000; Benefits; Elements of ISO 9001, ISO 9002, ISO 9003.
11. **Advanced techniques of TQM:** Design of experiments: failure mode effect analysis: Taguchi methods.

Reference Books:

- Sunder Raju, Total Quality Management, Tata McGraw Hill.
- M.Zairi, TQM for engineers, Aditya Books.
- J.L. Hradeskym, Total Quality Management Handbook, McGraw Hill.
- Dalela and Saurabh, ISO 9000 quality System, Standard Publishers.

BTAR714-18	Credits	L	T	P	Int	Ext
NON-CONVENTIONAL ENERGY RESOURCES	3	3	0	0	40	60

Course outcomes:

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

1. Address smart energy and green infrastructure
2. Build models that simulate sustainable and renewable green technology systems
3. Understand the history, global, environmental and economical impacts of green technology
4. Address non-renewable energy challenges

Course objectives:

1. To study basic concepts related to energy and its units .
2. To study various sources of renewable energy and energy storage systems

Unit I An introduction to energy sources, Environmental Aspects of Power Generation. Heat Transfer from Solar Energy, Physical principles of conversion of solar radiation into heat utilization, Flat Plate Collectors (FPC), Thermal losses and efficiency of FPC, Practical considerations for flat plate collectors, Applications of FPC – Water heating and drying, Focusing Type Collectors: orientation and sun tracking systems, Types of concentrating collectors – cylindrical parabolic collector, compound parabolic collector, Thermal performance of focusing collectors.

Unit II Solar energy storage system, Application of solar energy: solar water heating, space heating and cooling, solar photovoltaic, solar cooking, solar distillation & desalination, Solar industrial process heating, Solar power generation. Solar Green Houses, Solar thermo mechanical power, solar refrigeration & air conditioning, Solar ponds.

Unit III Energy from Biomass: Type of biomass sources, Energy plantation, Methods for obtaining energy from biomass, Biomass conversion technologies-wet and dry processes, Biodigestion, Community/Industrial biogas plants, Factors affecting bio digestion, Design of a biogas plant, Classification, advantages and disadvantages of biogas plants, Problems related to biogas plants, Utilization of biogas. Thermal gasification of biomass, Gasifier-classification, chemistry, advantages, disadvantages and application. Alcohol fuels from biomass: overview, feedstock, methods for alcohol production, Ethanol as an alternative liquid fuel; engine performance with alcohol fuels, biodiesel from biomass.

Unit IV Wind Energy: Basic principles of wind energy conversion: power in the wind, maximum power, forces on the blades, lift and drag, Components of wind energy conversion systems (WEC), Classification, advantages and disadvantages of WEC systems, Types of wind machines, Performance of wind machines, Design considerations, Energy storage, Application of wind energy, Environmental aspect. Tidal Energy. Components of tidal power plants, Single and double basin arrangements, Estimation of energy and power, Advantages and limitations of tidal power. Wave energy- its advantages and disadvantages, energy and power from wave energy.

Unit V Chemical Energy Sources: Fuel cells: Design, principle, classification, types, advantages and disadvantages, Work output and EMF of fuel cells, Application of fuel cells, Hydrogen energy, Properties of hydrogen, Methods of hydrogen production, Storage and transportation of hydrogen, Advantages and application.

Text Books:

1. G D Rai, 'Non-Conventional Energy Sources', Khanna Publishers. Delhi, 2010
2. S P Sukhatme, 'Solar Energy-Principles of Thermal Collection & Storage', Tata McGraw Hill Publishing Company Ltd., New Delhi

Reference Books

1. John A Duffie & William A Beckman, 'Solar Energy Thermal processes', Wiley Interscience publication .
2. P Garg & J Prakash,' Solar Energy - Fundamentals and Applications', Wiley Interscience publication. 3. Jay Cheng, 'Biomass to Renewable Energy Processes', 1st Edition, CRC press, 2009.