B. TECH (AUTOMATION & ROBOTICS)

STUDY SCHEME

BATCH 2018-19 ONWARDS

I.K.G.P.T.U KAPURTHALA

3rd Semester; Contact Hours: 28

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
BTAR303-18	Mathematics -III	3	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**

4thSemester; Contact Hours: 27

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	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	2	0	0	2	Non-Credit Mandatory Course			
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					**27**	**260**	**340**	**600**	**21**

5th Semester; Contact Hours: 28

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
BTAR505-18	Humanities -I	3	0	0	3	40	60	100	3
BTAR506-18	Electronics Devices and Circuits Lab	0	0	2	2	30	20	50	1
BTAR507-18	Computer Aided Design and Manufacturing Lab	0	0	2	2	30	20	50	1
BTAR508-18	Digital Electronics Lab	0	0	2	2	30	20	50	1
BTAR509-18	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**

6th Semester; Contact Hours: 29

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	Open Elective –II (Humanities)	3	0	0	3	40	60	100	3
BTAR606-18	Power Electronics and Drives 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**

7thSemester; Contact Hours: 28

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
BTAR702-18	Elements of Mechatronics	4	0	0	4	40	60	100	4
BTAR703-18	Flexible Manufacturing System	4	0	0	4	40	60	100	4
BTAR704-18	Elective-I	3	0	0	3	40	60	100	3
BTAR705-18	Advanced Robotics	3	0	0	3	40	60	100	3
BTAR706-18	Project -II	0	0	8	8	30	20	50	4
BMPD701-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**28**	**230**	**320**	**550**	**22**

8thSemester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	Credit Points
BTAR801-18	Modelling and Simulation	4	0	0	4	40	60	100	4
BTAR802-18	Mechanical Vibrations	3	1	0	4	40	60	100	4
BTAR803-18	Elective-II	3	0	0	3	40	60	100	3
BTAR804-18	Elective-III	3	0	0	3	40	60	100	3
BTAR805-18	Project-III	0	0	10	10	40	60	100	5
BTAR806-18	Modelling and Simulation Lab	0	0	2	2	30	20	50	1
BTAR807-18	Mechanical Vibrations Lab	0	0	2	2	30	20	50	1
BMPD801-18	Mentoring and Professional Development	0	0	2	2	Satisfactory / Unsatisfactory			Non-Credit
Total					**30**	**260**	**340**	**600**	**21**

LIST OF ELECTIVE PAPERS

Elective-I (Any one subject out of the following)

- BTAR708-18 Communication system
- BTAR709-18 Sensors & Signal Processing
- BTAR710-18 Micro-controller and PLC
- BTAR711-18 Linear Integrated Circuits
- BTAR712-18 Human Resources management

Elective-II (Any one subject out of the following)

- BTAR808-18 Neural Networks & FUZZY Systems
- BTAR809-18 Artificial Intelligence and expert systems
- BTAR810-18 Finite Element Analysis
- BTAR811-18 Relation data base management system
- BTAR812-18 Object oriented Programming using C++

Elective-III (Any one subject out of the following)

- BTAR813-18 Machine Vision System
- BTAR814-18 Design of Transmission systems
- BTAR815-18 Fluid Power Control
- BTAR816-18 Total Quality Management
- BTAR817-18 Electromechanically energy conversion and DC Machines

DETAILED SYLLABUS FOR 3rd AND 4th SEMESTER

3rd Semester; Contact Hours: 30

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
BTAR303-18	Mathematics -III	4	1	0	5	40	60	100	4
BTAR304-18	Fluid Mechanics and Fluid Machines	4	1	0	5	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					**30**	**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

Objectives:

1. To develop the student's knowledge in various robot structures and their workspace.
2. To develop student's skills in performing spatial transformations associated with rigid body motions and robot systems.
3. To provide the student with knowledge of the singularity issues associated with the operation of robotic systems.
4. To provide the student with some knowledge and analysis skills associated with trajectory planning and robot control.

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 ofoperations, 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 ofTransfer 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

Course Outcomes:

1. Students will demonstrate knowledge of the relationship between mechanical structures of industrial robots and their operational workspace characteristics.
2. Students will demonstrate an ability to apply spatial transformation to obtain forward kinematics equation of robot manipulators.
3. Students will demonstrate an ability to solve inverse kinematics of simple robot manipulators.
4. Students will demonstrate an ability to obtain the Jacobian matrix and use it to identify singularities.

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.

BTAR303-18 MATHEMATICS-III

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 encourage and enable students to: recognize that mathematics permeates the world around us.
2. To learn and solve signal problems.
3. To develop and solve real life problems using PDE.

Detailed Contents:

1. Fourier Series Periodic functions, Euler's formula. Even and odd functions, Change of Interval, half range expansions, Fourier series of different wave forms.
2. Laplace Transforms: Definition, Laplace transforms of various standard functions, properties of Laplace transforms, inverse Laplace transforms, transform of derivatives and integrals, Transform of multiplication and division by t, convolution theorem, Laplace transform of unit step function. Applications to solution of ordinary linear differential equations with constant coefficients.
3. Special Functions: Frobenius method for power series solution of differential equations, Bessel's equation, Bessel functions of the first and second kind, Legendre's equation, Legendre polynomial.
4. Partial Differential Equations: Formation of partial differential equations, Equations solvable by direct integration, Linear partial differential equations, homogeneous partial differential equations with constant coefficients. Solution by method of separation of variables, Applications: Wave equation and Heat conduction equation in one dimension. Solution of two-dimensional Laplace equation (Cartesian co- ordinates).
5. Functions of Complex Variable: definition of Limit, continuity, derivative of complex functions, and analytic function. Necessary and sufficient conditions for analytic function (without proof), Cauchy-Riemann equation (Cartesian and polar co-ordinates), harmonic functions, orthogonal system, determination of conjugate functions. Miller's Thomson method, Applications to fluid flow problems. Brief introduction to basic transformations, Bilinear transformations, complex integration: Line integrals in the complex plane, Cauchy's integral theorem, Cauchy's integral formula for analytic function and its derivatives. Taylor's and Laurent's expansions, singular points, poles, residue, Cauchy's Residue theorem, evaluation of real integrals by contour integration (F(*cosx, sinx*)

Course Outcomes:

1. Apply the fundamental concept of Fourier series and be able to give Fourier expansions of a given function.
2. Solve various first order differential equations with their applications.
3. Illustrate the mathematical aspects that contribute to the solution of heat and wave equations.

Suggested Readings/Books

1. Kreyszing Erwin, Advanced Engineering Mathematics, Wiley Eastern
2. B.S Grewal, Higher Engineering Mathematics, Khanna Publishers
3. N.K Jain, Numerical Solutions of Differential Equations, Prentice Hall
4. Sharma and Gupta, Differential Equations, Krishna Prakashan Media
5. N.P Bali, Text book of Engg. Mathematics, Laxmi Publishers

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 and analyze 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.

4th Semester; Contact Hours: 30

Code	Subjects	L	T	P	Total	Internal (Maximum Marks)	External (Maximum Marks)	Total Marks	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	2	0	0	2	Non-Credit Mandatory Course			
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					**30**	**290**	**360**	**650**	**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; press tools – 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 single stage 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 Graw Hill, 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.

EVS101-18 ENVIRONMENT SCIENCE

Sl. No.	Category	Course Code	Course Title	Hours per week			Total contact hrs,	Credits
				Lecture	Tutorial	Practical		
1	Mandatory Non-credit Course	EVS101	Environmental Studies	2	0	0	2	0

*** 40 Hours are kept for various activities under the head of activities. There will be a final theory examination for the students of 50 marks but these marks will not be added to their final result as assessment will be satisfactory or non-satisfactory.**

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.

BTAR407-18 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.