SCHEME & DETAILED SYLLABUS

(2nd year CBCS)

FOR

BACHELORS OF TECHNOLOGY

[Mechanical and Automation Engineering]

Offered by MAE Dept.

Indira Gandhi Delhi Technical University for Women

(Established by Govt. of Delhi vide Act 09 of 2012)

(Formerly Indira Gandhi Institute of Technology) Kashmere Gate

Delhi-110006

Course Structure for B.Tech Programme

First Year (Common courses for all B.Tech Programme)

		First Semester			
S.No.	**Subject Code**	**Subject Name**	**L-T-P**	**Credits**	**Category**
1.	BAS - 101	Applied Mathematics-I	3-1-0	4	**BAS**
2.	BAS-103	Applied Physics-I	2-1-2	4	**BAS**
3.	BAS-105	Applied Chemistry	2-1-2	4	**BAS**
4.	BMA - 110/BEC - 110	Engineering Mechanics/Basic Electrical Engineering	3-0-2	4	**OEC**
5.	BMA - 120/BMA -130	Workshop Practice/ Engineering Graphics	0-1-2	2	**OEC**
6.	HMC-110/ BCS - 110	Humanities and Social Science/Programming in C Language	3-1-0/ 3-0-2	4	**HMC/ OEC**
		Total		**22**	

		Second Semester			
S.No.	**Subject Code**	**Subject Name**	**L-T-P**	**Credits**	**Category**
1.	BAS -102	Applied Mathematics-II	3-1-0	4	**BAS**
2.	BAS -104	Applied Physics -II	2-1-2	4	**BAS**
3.	BAS -106	Environmental Science	2-1-2	4	**BAS**
4.	BEC - 110/BMA -110	Basic Electrical Engineering /Engineering Mechanics	3-0-2	4	**OEC**
5.	BMA- 130 /BMA -120	Engineering Graphics / Workshop Practice	0-1-2	2	**OEC**
6.	BCS - 110 / HMC -110	Programming in C language /Humanities and Social Science	3-0-2/ 3-1-0	4	**OEC / HMC**
		Total		**22**	

B.Tech.(MAE)

Third Semester (Second Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA -201	Production technology -I	3-0-2	4	**DCC**
2.	BMA -203	Strength of Materials	3-0-2	4	**DCC**
3.	BMA- 205	Thermal Engineering - I	3-0-2	4	**DCC**
4.	BAS -205	Numerical Techniques for Engineers	2-1-0	3	**BAS**
5.	BMA- 207	Machine Drawing Lab	0-0-2	1	**DCC**
6.	BMA- 253	Industrial Training	-	1	**DCC**
7.	GEC- 201	Generic Open Elective –I	2-0-0/ 1-1-0/ 0-0-4	2	**GEC**
8.	BEC -209	Analog and Digital electronics	3-0-2	4	**OEC**
	BCS - 201	Data Structures	3-0-2		
	BIT - 201	Database Management Systems	3-0-2		
	BAS - 201	Material Science and Engineering	3-1-0		
		Total		23	

Fourth Semester (Second Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1	BMA- 202	Production technology - II	3-0-2	4	**DCC**
2	BMA- 204	Theory of Machines	3-0-2	4	**DCC**
3	BMA -206	Engineering Materials	3-0-2	4	**DCC**
4	BMA- 208	Thermal Engineering-II	3-0-2	4	**DCC**
5	BCS -202	Computer Organization & Architecture	3-0-2	4	**OEC**
	BIT -204	Object Oriented Programming	3-0-2		
	BEC -210	Elements of Information Theory	3-1-0		
	BAS-202	Nano Structures & Materials in Engineering	3-1-0		
	BAS-204	Optical Engineering	2-1-2		
	BAS -206	Optimization Techniques	3-1-0		
6	HMC - 202	Disaster Management	1-0-2	**2**	**HMC**
		Total		**22**	

Fifth Semester (Third Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA -301	Machine Design	3-0-2	4	**DCC**
2.	BMA -303	Fluid Mechanics and Hydraulic Machines	3-0-2	4	**DCC**
3.	BMA -305	Automobile Engineering	3-0-2	4	**DCC**
4.	BMA -3XX	**Department Elective I**	3-0-2 /3-1-0	4	**DCE**
5.	HMC	Professional Ethics and Human Values	3-0-0	3	**HMC**
6.	BMA- 353	Industrial Training	-	1	**DCC**
7.	GEC -301	Generic Open Elective- II	2-0-0	2	**GEC**
		Total		22	

Sixth Semester (Third Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA- 304	Heat Transfer	3-0-2	4	**DCC**
2.	BMA -306	Computer Aided Design	3-0-2	4	**DCC**
3.	BMA -308	Production Management	3-0-0	3	**DCC**
4.	BMA -310	Advanced Machine Design Lab	0-0-2	1	**DCC**
5.	BMA -3YY	**Department Elective II**	3-0-2 /3-1-0	4	**DEC**
6.	BMA -3ZZ	**Department Elective III**	3-0-2 /3-1-0	4	**DEC**
7.	HMC-302 HMC-304 HMC-306 HMC-308	Principles of Management Marketing Management Financial Management Human Resource Management	**2-0-0** **2-0-0** **2-0-0** **2-0-0**	2	**HMC**
		Total		22	

Seventh Semester (Fourth Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1.	BMA- 401	Finite Element Analysis	3-0-2	4	**DCC**
2.	BMA- 403	Mechatronics	3-0-2	4	**DCC**
3.	BMA- 451	Minor Project	0-0-8	4	**DCC**
4.	BMA- 453	Industrial Training / Internship	-	1	**DCC**
5.	BMA- 4XX	**Department Elective IV**	3-0-2 /3-1-0	4	**DEC**
6.	BMA- 4YY	**Department Elective V**	3-0-2/ 3-1-0	4	**DEC**
		Total		21	

Eighth Semester (Fourth Year)

S.No.	Subject Code	Subject Name	L-T-P	Credits	Category
1	BMA -402	Computer Aided Manufacturing	3-0-2	4	**DCC**
2	BMA -404	Robotics and Computer Integrated Manufacturing	3-0-2	4	**DCC**
3	BMA- 452	Major Project	0-0-16	**8**	**DCC**
4	BMA- 4ZZ	**Department Elective VI**	3-0-2 /3-1-0	4	**DEC**
5.	GEC-402	Generic Open Elective III	**0-2-0 0-0-4 2-0-0**	2	**GEC**
		Total		22	

Note: All Industrial training / Internships will be done in summer break of previous academic session. Assessment for the same will be done within first two weeks of opening of academic session by department.

List of Department Elective Courses

Category	Course Code	Subject	Credit
Department Elective Course – I	BMA-307	Mechanical Vibration	3-0-2
	BMA-309	Introduction to composites	3-0-2
	BMA-311	Automation in Manufacturing	3-0-2
	BMA-313	IC Engines	3-0-2
	BMA-315	Artificial Intelligence	3-0-2
Department Elective Course – II	BMA-312	Metal Forming & Casting	3-0-2
	BMA-314	Advanced Strength of Materials	3-0-2
	BMA-316	Quality Management & Six Sigma Applications	3-0-2
	BMA-318	Gas Dynamics	3-1-0
	BMA-320	Design of Mechanisms	3-0-2
Department Elective Course – III	BMA-322	Industrial Tribology	3-0-2
	BMA-324	Power Electronics	3-0-2
	BMA-326	Power Plant Engineering	3-0-2
	BMA-328	Combustion, Emission and Pollution Control	3-0-2
	BMA-330	Measurement and Meteorology	3-0-2
Department Elective Course – IV	BMA-405	Tool Engineering	3-0-2
	BMA-407	Welding Technology	3-0-2
	BMA-409	Mechanical Modeling and Simulation	3-0-2
	BMA-411	Flexible Manufacturing System	3-0-2
	BMA-413	Refrigeration and Air-Conditioning	3-0-2
	BMA-415	**E-Learning Based Course-1	
Department Elective Course – V	BMA-417	Agile Manufacturing	3-0-2
	BMA-419	Hydraulic & pneumatic Control	3-0-2
	BMA-421	Ergonomic design	3-0-2
	BMA-423	Computational Fluid Dynamics	3-0-2
	BMA-425	Hydraulic Machines and Hydro-Power Plant	3-0-2
	BMA-427	**E-Learning Based Course-2	
Department Elective Course – VI	BMA-406	Advanced Machine Design	3-0-2
	BMA-408	Maintenance and Reliability	3-0-2
	BMA-410	Reverse Engineering and Rapid Prototyping	3-0-2
	BMA-412	Non-conventional Manufacturing Processes	3-0-2
	BMA-414	Product design & Development	3-0-2
	BMA-416	**E-Learning Based Course-3	
	BMA-418	Fracture Mechanics	3-0-2
	BMA-420	Non-conventional Energy resources	3-0-2
	BMA-422	Cogeneration and Improved Power cycles	3-0-2
	BMA-424	MEMS & NEMS	3-0-2
	BMA- 426	Design of Experiments	3-0-2

Production Technology-I	
Course Code: BMA-201 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction: This course focuses on the introduction to mechanical manufacturing methods by which materials are economically processed into different shapes. We study different types of material removing and shaping process to convert a material to desired shape.

Course Objectives: The Objective of this course is to

- Familiarize the student with different production process
- Make them able to decide proper process production process for real time economic production.

Pre-Requisites: Workshop Practice

Course Outcomes: Having successfully completed this course, the student will:

CO1: Have sound knowledge of basic mechanical operations and different casting processes.
CO2: Be able to evaluate different welding techniques.
CO3: Have knowledge about forming and rolling processes.
CO4: Have knowledge about powder metallurgy and additive manufacturing.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents:

UNIT I	11 Hours
General Introduction- Manufacturing; definition and broad classification **Casting** – Sand mould casting, Pattern types, Design of pattern, testing of moulding sand, Cores, Gating systems, Principle, process and applications of Die casting, Centrifugal casting, Investment casting, and Continuous casting, Melting of metal for casting, Casting defects their causes and remedies, Cleaning and Inspection of castings, Foundry mechanization.	
UNIT II	11 Hours
Welding- Fusion welding, Principle, equipment, and applications of Arc Welding, Gas Welding, Submergedarc welding, TIG and MIG, Induction welding; Plasma arc welding, Resistance welding, Solid state welding, Ultrasonic Welding, Electron Beam Welding (EBW) and Laser Beam Welding (LBW). Edge preparation, Types of joints, welding techniques and position. Welding defects, their causes and remedies.	
UNIT III	11 Hours
Forming Processes – Introduction, General principles, major classification, Hot working and cold working; principle, advantages and applications, Forging Definition and classification, work materials different forging operations, tools and equipment, drop forging and press forging (pressing) methods and use, Forgingdies types and design calculations. **Rolling**-Introduction, basic principles and general applications, Characteristics and applications of hot rolling and cold rolling; various rolling processes, Wire drawing and Extrusion, Basic principles and requirements, Classification, methods and applications,	
UNIT IV	11 Hours
Powder Metallurgy Introduction, Production of metal powders, Compaction and sintering processes, Secondary and finishing operations, advantages, limitations and applications of powder metallurgy. Case Study **Additive Manufacturing** Introduction to 3-D Printing, Stereo lithography, Selective Laser Sintering, Fused Deposition Modelling.Case study	

Text Books	
1.	Rao, P.N. “Manufacturing technology: foundry, forming and welding”: McGraw-Hill, 2018.
2.	Ghosh, A., & Mallik, A. K. “Manufacturing science”, 2nd Edition, Ellis Horwood, 1986.
3.	Raghuwanshi B. S, “A Course in Workshop Technology Vol. 1”, 1st Edition, Dhanpat Rai and Sons, 2015.
4.	Hazra Chaudhuri S. K., “Elements of workshop Technology Vol. 2”, 1st Edition, Media Promoters, 2008.
5.	Kai, Chua Chee, Fai Leong, “Rapid Prototyping: Principle & Application in Manufacturing”, 1st Edition, John Willey, London, 2003.
Reference Books/Material	
1.	Kalpakjian, S., & Schmid, S. R. “Manufacturing processes for engineering materials”, 6th Edition, Pearson Education, 2008.
2.	Groover, M. P. “Introduction to manufacturing processes”. 1st Edition, Nashville, TN: John Wiley &Sons. 2012.
3.	www.nptel.ac.in
4.	http://ocw.mit.edu

Strength of Materials	
Course Code: BMA-203 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction: Strength of materials subject is basically the branch of mechanics which deals the study of forces on deformable solids. The study of strength of materials often refers to various methods of calculating the stresses and strains in structural members, such as beams, columns, and shafts. The methods employed to predict the response of a structure under loading and its sensitivity to various failure modes takes into account the properties of the materials.

Course Objectives:

- To get detailed analysis of the stress and strain behaviours in deformable solids
- To find deflections in different elements when these elements are under bi axial state of stress.
- Evaluate the allowable loads and associated allowable stresses before mechanical failure.
- Understand the adequacy of mechanical and structural elements under different loads is essential for the design and safe evaluation of any kind of structure.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: BMA-110 (Engineering Mechanics)

Course Outcomes: Having successfully completed this course, the student will be able to

CO1: Understand basic concepts of compound stresses & strains, stresses in beams, deflection of beams.
CO2: Analyze and solve problems related to fixed beams, continuous beams and torsion bars.
CO3: Apply the concept of springs, columns and struts in engineering application.
CO4: Solve stresses in thin pressure vessel, thick pressure vessel and bending of curved bars.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Simple Stresses & strains: Tensile, Compressive, shear and volumetric stresses and Strains, stress strain diagram, complementary shear stress, lateral strain and Poisson's ratio. **Compound bars and Temperature stresses**: Stresses in compound bars carrying axial loads and subjected to temperature stresses. **Compound Stresses & Strains:** Two dimensional stress system, conjugate shear stress at a point on a plane, principal- planes, principal stresses, Mohr's circle for plane stresses, Plane strain.	
UNIT II	11 Hours
Simple bending: Shear force and bending moment diagrams of cantilevers, simply supported beams under concentrated, uniformly loaded and varying loads with and without overhangs. **Stresses in Beams:** Combined bending and direct stresses, bending stresses in beams, bending stresses in composite beams, shearing stress in beams. **Deflection of Beams:** Moment curvature relation, direct integration method, Macaulay's and moment-area method, theories of elastic failures, strain energy due to bending, Castigliano's theorem.	
UNIT III	10 Hours
Fixed Beams: Macaulay's method for built-in beams, moment area method for fixed beams. **Continuous beams**: Clapeyron's theorem, beams with overhang, continuous beams with fixed ends. **Torsion**: Torsion of circular shafts, strain energy due to torsion, shaft under action of varying torque, shaft in series and parallel, compound shafts, combined bending and torsion.	
UNIT IV	10 Hours
Springs: Closed and open coil helical spring subjected to axial load, spring in parallel & series. C**olumns and Struts**: Elastic stability of columns, buckling of columns, slenderness ratio and conditions, derivations of Euler's formula for elastic buckling load, Equivalent lengths and Rankine Gordon empirical Formulae. **Thin Pressure Vessel:** Thin Pressure Vessels, Circumferential and longitudinal stresses in thin cylindrical shells and thin spherical shell under internal pressure. **Thick Pressure Vessel:** Lame's theory.	

Text Books	
1.	R.K. Rajput, "Strength of Materials", S. Chand Publication, New Delhi, 1998.
2.	Ryder G.H., "Strength of Materials", Macmillan, Delhi, 2003.
3.	R.K. Bansal, "Strength of Materials", Laxmi Publication, New Delhi, 2001.
Reference Books	
1.	Timoshenko S.P., "Elements of Strength of Materials", E-W. P, N. Delhi, 2000.
2.	Hibbler R.C., "Mechanics of Materials", Prentice Hall, New Delhi, 1994.
3.	Popov Eger P., "Engg. Mechanics of solids", Prentice Hall, New Delhi, 1998.

THERMAL ENGINEERING I	
Course Code: BMA-205 Contact Hours: L-3 T-0P-2 Course Category: DCC	Credits: 4 Semester: 3

Introduction: Thermal Engineering is a specialized sub-discipline of Mechanical Engineering that deals exclusively with heat energy and its transfer between not only different mediums, but also its transformation into other usable forms of energy. The basis of all thermal engineering topics is thermodynamics. Therefore, in this course, initially the emphasis has been given on advanced principles of thermodynamics. It is then followed by the studies on the components of steam power plant

Course Objectives:

- To get a better understanding of various laws and principles of thermodynamics and their applications in analyzing the processes taking place in heat engines.
- To provide a good platform to mechanical engineering students to understand, model and appreciate concept of dynamics involved in thermal energy transformation.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: NIL

Course Outcomes: Having successfully completed this course, the students will have:

CO1: Knowledge about the laws of thermodynamics to analyze the processes taking place in a steampower plant and other thermal systems.

CO2: Knowledge about concepts of entropy, availability and irreversibility and different thermodynamic relations.

CO3: Basic knowledge of the gas power cycles and steam and its properties.

CO4: Basic knowledge about the vapor power cycles.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Fundamentals of Thermodynamics: Thermodynamic System, Microscopic and Macroscopic Point of View, Property and State, Equilibrium, Process, Concept of Reversibility, Work, Heat, Ideal Gas, Zeroth Law of Thermodynamics. First Law of Thermodynamics, Corollary of First Law of Thermodynamics, Internal Energy, First law applied to a closed system and open system, SFEE. **Second Law of Thermodynamics**: Clausius and Kelvin Planck statements, Equivalence of two statements, Carnot Theorems, Clausius Theorem.	
UNIT II	11 Hours
Entropy: Definition, Clausius inequality, Entropy a point function, Principle of increase of entropy, Entropy change during constant volume, isothermal, constant pressure and polytropic processes, Numerical problems. **Availability and Irreversibility:** High and low grade energy, Available and unavailable energy, Loss of available energy due to heat transfer through finite temperature difference,	

Availability, Availability of a non-flow or closed system, Availability of a steady flow system, Helmholtz and Gibbs functions, Irreversibility, Numerical problems.
Thermodynamic relations: Reciprocal and cyclic relations, Property relations, Maxwell relations, Tds equations, Heat capacity relations, Relations for internal energy and enthalpy.

UNIT III	10 Hours

Gas Power cycles: Carnot cycle, Otto cycle, Diesel cycle, Dual cycle, Stirling and Ericsson cycles, Brayton cycle, Numerical problems.
Steam and its properties: Phase transformation of water on p-v, T-v, T-s and h-s diagrams, Properties of saturated water, wet steam, dry saturated steam and superheated steam, Steam Tables and Mollier chart for thermodynamics properties, Measurement of dryness fraction, Numerical problems.

UNIT IV	10 Hours

Vapor Power Cycles: Rankine cycle, Comparison of Rankine and Carnot vapor cycles, Methods of improving the performance of Rankine cycle, Superheating, Reheating, Regenerative cycle, Binary vapor cycle, Numerical problems.
Combustion of Fuels: Combustion reactions, First law applied to a combustion reaction, Mass balance, Energy balance, Stoichiometric air-fuel ratio, Actual air-fuel ratio from the analysis of products, Enthalpy of formation, Heat of combustion, Heating Values-Enthalpy of combustion, Adiabatic flame temperature.

Text Books

1.	Cengel and Boles, “Thermodynamics: Engineering Approach”, Tata McGraw-Hill Companies, 2011.
2.	P. K. Nag, “Engineering Thermodynamics”, Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2011.
3.	Van Wylen and Sonntag, “Fundamentals of Classical Thermodynamics”, John Wiley & Sons Inc., 2002.
4.	P. L. Ballaney, “Thermal Engineering”, Khanna Publishers, Delhi, India,2012.

Reference Books

1.	Michael J. Moran, Howard N. Shapiro, “Fundamentals of Engineering Thermodynamics”, John Wiley & Sons Inc.
2.	P. K. Nag, “Power Plant Engineering”, Tata McGraw-Hill , New Delhi, India.2012
3.	S. C. Arora and S. Domkundwar, “A course in Power Plant Engineering”, Dhanpat Rai & Sons, Delhi, India., 2012.
4.	M.M. El Wakil, “Power Plant Engineering”, Tata McGraw-Hill Companies, 2002.

NUMERICAL TECHNIQUES FOR ENGINEERS	
Course Code: BAS-205 Contact Hours: L-2 T-1 P-0 Course Category: AEC	Credits: 3 Semester: 3

Introduction: Numerical Methods give insight into problems we cannot otherwise solve. These methods provide us the way to solve problem when exact methods fails or unable to produce the desirable results.

Course Objectives:

- To motivate the students to understand and learn various numerical techniques to solve mathematical problems representing various engineering, physical and real life problems.
- To provide constructive methods for obtaining answers to such problem for which analyticalmethods fails to find solutions.

Pre-requisites: Calculus, Differential equations, some exposure to linear algebra (matrices) helps.

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

CO1: Evaluate how to obtain numerical solution of nonlinear equations using bisection, secant, Newton, and fixed-point iteration methods.
CO2: Solve system of linear equations numerically using iterative methods.
CO3: Understand how to approximate the functions using interpolating polynomials.
CO4: Solve differential equations numerically.

Pedagogy: Apart from class room teaching, main focus is to enhance problem solving ability supported by weekly assignments and discussing individual's doubts.

Content

UNIT-I	7 Hours
Floating-Point Numbers: Floating-point representation, rounding, chopping, error analysis, -conditioning and stability, Convergence of iterative methods. Non-Linear Equations: Bisection, secant, fixed-point iteration, Newton method for simple and multiple roots, their convergence analysis and error analysis.	
UNIT-II	7 Hours
Linear Systems and Eigen-Values: LU decomposition, Gauss Seidel iteration method, Successive-over-relaxation (SOR) iteration methods and their convergence, ill and well-conditioned systems, Rayleigh's power method for eigen-values and eigen-vectors.	
UNIT-III	6 Hours
Interpolation and Approximations: Finite differences, Newton's forward and backward interpolation, Lagrange and Newton's divided difference interpolation formulas with error analysis. Numerical Integration: Newton-Cotes quadrature formulae (Trapezoidal and Simpson's rules) and their error analysis, Gauss-Legendre quadrature formulae.	
UNIT-IV	8 Hours
Differential Equations: Solution of initial value problems using Picard, Taylor series, Euler's and Runge-Kutta methods (up to fourth-order), system of first-order and second-order differential equations.	

Text Books	
1	Jain M.K., Iyengar, S.R.K., and Jain, R.K. Numerical Methods for Scientific and Engineering Computation, 6th Edition, New Age International Publication,2012.
2	Sastry S., Introductory Methods of Numerical Analysis, 5th Edition, Prentice Hall India Learning Private Limited; 2012.
3	Conte, S.D and Carl D. Boor, Elementary Numerical Analysis: An Algorithmic approach, SIAM-Society for Industrial and Applied Mathematics, 2017.
4	Grewal, B. S. , "Higher Engineering Mathematics", 44thEdition, Khanna Publishers, 2012.
Reference Books	
1	Gerald C.F and Wheatley P.O., Applied Numerical Analysis, 8 Edition, Pearson Education, 2011.
2	Chappra S.C., Numerical Methods for Engineers, 7th Edition, McGraw-Hill Higher Education, 2014.

Machine Drawing Lab	
Course Code: BMA-207 Contact Hours: L-0 T-0P-2 Course Category: DCC	Credits: 1 Semester: 3

Introduction: Technical Graphics is used to communicate the necessary technical information required for manufacture and assembly of machine components. These drawings follow rules laid down in national and International Organizations for Standards (ISO). Hence the knowledge of the different standards is very essential. Students have to be familiar with industrial drafting practices and thorough understanding of production drawings to make themselves fit in industries.

Course Objectives:

- Provide the fundamental concepts of machine drawing elaborating on how to concretize the idea of new structure such as a machine element.
- Study the conventions and rules to be followed by engineers for making accurate drawings.
- Understand the basic dimensioning practices that have to be followed in the preparation of drawings.
- Help the student in the visualization of assembly and sub assembly of various machine elements.
- Train the students in the preparation of assembly drawings

Pre-Requisites: BMA-130 Engineering Graphics

Course Outcomes:

Having successfully completed this course, the students will be able to:

CO1: Visualize and draw a Mechanical Engineering part and joints.
CO2: Design a system, component or process to meet desired needs within realistic constraints.
CO3: Identify, formulate, and solve engineering drafting and drawing problems.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

List of Experiments:

To design and draw:

1) Forms of thread
2) Different types of bolts and rivets
3) Knuckle joint

4) Flange coupling
5) Universal coupling
6) Rivet joint
7) Threaded joint
8) Gib and cotter joint
9) Screw jack
10) Stuffing box
11) Connecting rod
12) Plumber Block
13) Multi plate clutch

Text Books	
1.	Gill P.S., A Textbook of Machine Drawing ,Katson Publishing, 2013.
2.	Bhatt, N.D., Machine Drawing, Charotar Publishing House Pvt. Limited, 2014.

Operations Management	
Course Code: BMA 210 Contact Hours: L-3 T-1P-0 Course Category: OEC	Credits: 4 Semester: 3

Introduction: This course provides a general introduction to operations management. Operations management is the design and control of business processes, that is, the recurring activities of a firm. Along with finance and marketing, operations is one of the three primary functions of a firm. At the risk of being simplistic, one may say that marketing generates the demand, finance provides the capital, and operations produces the product or delivers the service. More generally, operations spans the entire organization: COOs are in charge of R&D, design/engineering, production operations, marketing, sales, support and service.

Course Objectives: This course considers the operations from a managerial perspective .

- To explain the performance measures of operations viz. productivity, quality and effectiveness.
- Deliver important concepts such as location decision, facility layout, forecasting, production scheduling, inventory management, replacement analysis are discussed.
- Provide a fair understanding of the role of a Production / Operations Manager in business processes.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: NIL

Course Outcomes: Upon completion of this course, the students will be able to –

CO1: Explain the concept of operations management and production management

CO2: Illustrate different types of production layout, method study and work study

CO3: Describe inventory management and material requirement planning

CO4: Analyse different types of maintenance procedure

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Introduction –Introduction to productivity, Multi Factor productivity, Principles of management, Organization structure. **Capacity Planning, Plant Location and Plant Layout** – Introduction, need for selecting a suitable location, Location Factors, Quantitative Method, Principles of Plant layout, Types of Layout **–** Product, Process, Fixes Position, Cellular Layout.	
UNIT II	11 Hours
Demand Forecasting-Need for demand forecasting, Techniques of forecasting, Time series analysis, Least Square Method, Moving Average, Exponential Method and QualitativeTechniques. **Method Study**- Introduction, Objectives Steps, Micromotion Study, Cycle graph andchrono cycle graph, Therbligs and SIMO charts. **Work Study** – Objectives, Different Techniques, Standard Time, Allowances, Time studyNumerical, Performance Rating, Work sampling. Process and Product Life Cycle, **Material Requirement Planning –** Introduction, MRP objectives, Functions served by MRP Production Planning and Control, Supply chain and Logistics Management, Production Scheduling.	
UNIT III	10 Hours
Inventory Management - Introduction, Reasons for Holding Inventories, Relevant Costs of Inventories, EOQ models, Quantity Discount Models, Safety Stock, Inventory controlsystem, Selective Control of Inventory ABC analysis, VED analysis. **Production Cost Concepts** – Introduction, Cost of Production, Classification and analysisof Cost, break even analysis, Make and Buy.	
UNIT IV	10 Hours
Industrial Maintenance – Concepts of Maintenance, Organisation for Maintenance department, Types of Maintenance-Preventives, Breakdown and Corrective Maintenance,Failure Analysis, Maintenance Performance, Replacement policies of machines.	

1.	Martinich, J.S., Production and Operations Management: An Applied Modern Approach", John Wiley and Sons, New Delhi, 2008.
2.	Richard B. Chase, Nicholas J.A., Jacobs, F.R., "Production and Operation Management", Tata McGraw Hill, New Delhi, 1998.
3.	Ravi Shankar, "Industrial Engineering and Management", Galgotia Publications.
Reference Books	
1.	Paneerselvam, R., "Production and Operations Management", Prentice Hall India, 2012.
2.	Khanna, O.P., "Industrial Engineering and Management", Dhanpat Rai & Sons, 1985.

Production Technology- II	
Course Code: BMA-202 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction: At the heart of any manufacturing system is a set of processes which change the size, shape and form of raw materials into the desirable thus giving an industrial nation the power of growing. This course is an introductory course for engineering professionals who would like to take up careers in manufacturing particularly at the process level.

Course Objectives: The objective of this course is

- To familiarize the student with all conventional Machine Tools and to make them able to decide proper process of machining for real time economic manufacturing operations.
- Learn the fundamentals of machining, optimization, non-conventional machining, fixturing and metrology
- Develop first order mathematical descriptions for selected processes
- Understand the advantages and limitations of various processes in terms of quality productivity
- Apply this knowledge to manufacturing process selection, design and part quality

Pre-Requisites: Production Technology I

Course Outcomes: Having successfully completed this course, the student will be able to

CO1: Classify Machine Tools and their operations
CO2: Illustrate Lathe, Drilling operations and their components
CO3: Describe Milling and Grinding operations
CO4: Analyse machining time for Lathe, Drilling and Milling.

Pedagogy: The teaching-learning of the course would be organized through lectures, tutorials, assignments, projects/ presentations and quizzes. Faculty members strive to make the classes interactive so that students can correlate the theories with practical examples for better understanding. Use of ICT, web-based resources as well as flipped class room teaching will be adopted.

Contents:

UNIT I	11 Hours
Introduction: Classification of machine tools based on application and production rate: General purpose, Single purpose and Special purpose machines, Classification based onTypes of machine tools and the processes, Generating and forming **Single Point cutting tool nomenclature** Elements of tool geometry, cutting tool & its Materials and applications. **Lathe -** Centre lathe, facing lathe, gap-bed lathe, capstan and turret lathe, CNC lathe, major difference between CNC lathe and conventional lathe. Major sub-assemblies- Bed, Livestock, tail stock, carriage consisting of saddle, cross-slide, compound Slide tool post and apron, Work holding devices: self-centering three jaw chuck, Independent, four jaw chuck, collets, face plates, dog carriers, centers and mandrels. Driving mechanisms, apron mechanism, thread cutting mechanism and Calculations, features of half-nut engagement – disengagement, indexing dial mechanism.	
UNIT II	11 Hours
Operations on lathe: taper turning, related calculations, thread cutting, facing, under-Cutting, Drilling, boring, parting-off, knurling, is chamfering. Reciprocating Type Machine Tools- Shaper, Planer and Slotter, Constructional features, Basic Machines and kinematics and related calculations **Drilling Machines**: Classification and uses, Constructional features of bench drilling machine, radial drilling machine, multi-spindle drilling machine, feed mechanism, work Holding devices, Tool –	

holding devices. Different drilling operations: Drilling, reaming, Counter boring and countersinking etc., estimation of drilling time.	
UNIT III	11 Hours
Milling Machines: Types of general-purpose milling machines- horizontal, vertical and Universal. Types of milling cutters and their applications, different milling operations, work holding devices- vice, clamps, chucks, dividing head and its use, simple, compound and differential indexing. Indexing calculations and machining time calculations. Introduction to machining centers	
UNIT IV	11 Hours
Grinding Machines: Different types of grinding machines: cylindrical, surface and center-less grinding machines, basic constructional features and mechanisms, specifications, Wheel Dressing and Wheel Truing Specifications of grinding wheel, Effect of grinding conditions and type of grinding on wheel behavior, equivalent diameter of grinding wheel. Introduction to honing, lapping and super-finishing processes.	
Text Books	
1.	P.N. Rao, "Manufacturing Technology: Metal Cutting & Machine Tools", 4th Edition, McGraw Hill Higher Education, 2013.
2.	Serope Kalpakjian and Steven Schmid, "Manufacturing Engineering & Technology", 7th Edition, Pearson Education 2013.
3.	B.S. Raghuwanshi, "Workshop Technology Vol.2"1st Edition, Dhanpat Rai & Sons, 2013.
4.	Hajra Chandhari, S.K., Nirjhar and Roy S.K., "Elements of Workshop Technology Vol.2", 1st Edition, Media Promoters,2018.
Reference Books	
1.	P.C. Sharma, "A Text Book of Production. Engineering", 10th Edition, S. Chand, New Delhi, 2004.
2.	Jain, K. C., & Chitale, A. K. "Textbook of Production Engineering", 2nd Edition, PHI Learning2014.
3.	Bawa H.S., "Workshop Technology Vol.2", 2nd Edition, Tata McGraw Hill, 2004.
4.	Juneja, "Fundamental of Metal Cutting", 1st Edition, New Age Publications, 2017
Internet Sources:	
1.	www.nptel.ac.in
2.	http://ocw.mit.edu

Theory of Machines	
Course Code: BMA-204 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction: This is an important core mechanical design subject. This is a prerequisite for understanding machine design subject and students have to understand problems involved in designing mechanisms.

Course Objectives: The objectives of this course are

- To develop basic concepts of kinematics and dynamics in machines.
- To explain the concepts and formulas to be used for designing mechanism with linkages, using cams, gears, balancing and vibrations.
- To introduce the approaches and mathematical models used in kinematic and dynamic analysis of machinery.
- To give basic knowledge on kinematic and dynamic design of machinery.
- To give basic knowledge on mechanical vibrations.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: BMA-110: Engineering Mechanics

Course Outcomes: Having successfully completed this course, the student will be able to -

CO1: Understand general concepts of kinematics pair.
CO2: Analyze different types of cam profile for a given data.
CO3: Understand the basics of dynamic analysis.
CO4: Understand vibration and gyroscopic effect.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
General concepts, Velocity and Acceleration Analysis: Introduction of Simple mechanism, Different types of Kinematics pair, Grublers rule for degree of freedom, Grashof's Criterion for mobility determination Inversions of 3R-P, 2R-2P chains, Kinematic analysis of planar mechanism.	
UNIT II	11 Hours
Cams: Classification, Cams with uniform acceleration and retardation, SHM, Cylcloidal motion, oscillating followers. **Vibrations:** Vibration analysis of SDOF systems, natural, damped forced vibrations, based excited vibrations, transmissibility ratio.	

UNIT III	10 Hours
Gears: Geometry of tooth profiles, Law of gearing, involute profile, interference, helical, spiral and worm gears, simple, compound gear trains, Epicyclic gear trains–Analysis by tabular and relative velocity method, fixing torque. **Dynamic Analysis:** Slider-crank mechanism, turning moment computations.	
UNIT IV	10 Hours
Balancing: Static and Dynamic balancing, balancing of revolving and reciprocating masses, single and multi-cylinder engines. **Gyroscopes:** Gyroscopic law, effect of gyroscopic couple on automobiles, ships, aircrafts.	
1.	S.S. Rattan, "Theory of Machines", Tata McGraw Hill, 2000
2.	Dr. V.P. Singh, "Theory of Machines", Dhanpat Rai & Co. (P) Ltd., 2001
3.	Ghosh & A.K. Mallik, 'Theory of Mechanisms and Machines", East West, Press, 2012.
Reference Books	
1.	Jagdish Lal, "Theory of Mechanism & Machines", Metropolitan Education, 2000
2.	Thomas Beven, "The Theory of Machines", CBS Publishers, 2000.
3.	P.L. Ballaney, "Theory of Machines & Mechanism", Khanna Publishers, 23rd Edition, 2003.
4.	Norton, 'Kinematics and Dynamics of Machinery', Tata McGraw Hill, 2011.
5.	Khurmi R.S., Gupta J.K., "Theory of Machines", S. Chand & Co. Ltd.

Engineering Materials	
Course Code: BMA-206 Contact Hours: L-3 T-0 P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction: This course provides an overview of Engineering Materials as a basis for understanding how structure/property/processing relationships are developed and used for different types of materials

Course Objectives:

- To understand how and why the properties of materials are controlled by structure and bonding at the atomic-scale, and by features at the micro-structural and macroscopic levels.
- To understand the design, selection and processing of materials for a wide range of applications in engineering and elsewhere.
- To understand how and why the structure and composition of a material may be controlled by processing.

- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: NIL

Course Outcomes: After taking this course students will be able to

CO1: Evaluate structure of metals and imperfection in solids.
CO2: Analyze phase and equilibrium diagram.
CO3: Understand different heat treatment processes and types of corrosion
CO4: Analyze failure of the materials and dislocations and strengthening mechanisms in solids.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Structure of metals: Crystal structure, crystal systems, crystallographic points, directions and planes, linear and planar density computations, Single crystal, polycrystalline materials, Anisotropy, Polymorphism and anisotropy X-Ray diffraction technique. **Imperfection in solids:** Point defects, vacancies, linear defects, interfacial defects, volume defects, effect of crystal defects on mechanical properties of the materials, grain size determination.	
UNIT II	11 Hours

Materials: Classifications of Cast Iron, steels and their alloys, effect of alloying elements, properties, IS standards codes for Cast iron and steels, composite materials and non-metals.

Phase and Equilibrium Diagrams: Unary and binary phase diagrams, phase equilibria, phase rule, types of equilibrium diagrams, solid solution types, Iron- Carbon diagrams. Microstructural Exam: Grain size determination, Comparative study of microstructure of various metals such as mild steel, CI, brass.

UNIT III	10 Hours

Heat Treatment: Principles and purpose of heat treatment of plain carbon steels, annealing, Normalizing, hardening, tempering, isothermal treatment, case hardening – carburizing, nitriding etc, precipitating hardening of aluminum alloys, cooling curves.

Corrosion: Types of corrosion, Galvanic cell, rusting of Iron, Methods of protection from corrosion.

UNIT IV	10 Hours

Failure of the materials: Ductile fracture and brittle fracture; Fatigue failure, Design considerations for fatigue failure, Creep failure of the materials and creep resistant materials.

Dislocations and strengthening mechanisms in solids: Slip systems, slip in single crystal, twinning, Hall-Petch equation, solid-solution strengthening, strain hardening, recovery, recrystallization and grain growth.

Text Books

1.	V. Raghavan, "Material Science & Engineering", Prentice Hall India Ltd., 2001.
2.	William D. Callister, "Material Science & Engineering" Wiley India Ltd., 2010.
3.	Sidney H. Avner, "Introduction to Physical Metallurgy", Tata McGraw-Hill,

2007. Reference Books

1.	Porter and Easterling, "Phase transformation in metals and alloys", Van Nostrand Reinhold Company Ltd, 1999.
2.	Reed Hill, "Principles of Physical Metallurgy" Cengage Learning Ltd, 2009
3.	Budinski et al, "Engineering Materials & Properties", Prentice Hall India, New Delhi, 2004.
4.	Peter Haasen, "Physical Metallurgy", Cambridge Univ. Press, 1996.

THERMAL ENGINEERING II	
Course Code: BMA-208 Contact Hours: L-3 T-0P-2 Course Category: DCC	Credits: 4 Semester: 4

Introduction: This course discusses about the processes in an open and close system, the basic laws on heat transfer processes and their application, as well as the combustion occurs inside the engine cylinder. Analysis of compressors and gas turbines come under this course.

Course Objectives:

- The Objective of this course is to familiarize the student with the basics of compressors and engine performance with combustion analysis.
- To appreciate concept of dynamics involved in thermal energy transformation in power plants.
- The students are to be provided hands on practical exposure on topics covered in the course.

Pre-Requisites: BMA-205: Thermal Engineering I

Course Outcomes: Having successfully completed this course, the student will be able to

CO1: Have knowledge about reciprocating and centrifugal air compressor.
CO2: Apply laws of thermodynamics in practical life such as engines and compressors.
CO3: Analyze the Gas Turbines
CO4: Understand the concepts of compressible fluid flow fundamentals.

Pedagogy: Classroom teaching is supported by White board, black board, chalks, markers, projector and screen. The hand written notes, PowerPoint slides and assignments will be provided to the students and also mailed to them. The students can also raise their issues related to the course in the class and mail.

Contents:

UNIT I	11 Hours
Reciprocating Air Compressor - Single stage compressor: Equation for work, Isothermal, adiabatic and polytropic compression, Isothermal and adiabatic efficiency, Volumetric efficiency, Effect of clearance, Multi-stage compression with inter cooling. **Centrifugal Air Compressor** – Constructional details, working principle, Static and total heads, Velocity diagrams and theory of operation, Work done by impeller, Losses and isentropic efficiency of compressor, Prewhirl, Surging and choking of compressors.	
UNIT II	11 Hours
Fundamentals of IC Engines - Classification, Engine components and basic terminology, two stroke and four stroke engines, SI and CI engines, Theoretical and actual indicator diagrams, Valve and Port timing diagram, Components of IC Engine and their functions, Battery ignition system for SI engines, Fuel Injection system for CI Engines, Basics of Cooling and lubrication systems for IC engines, Detonation in SI Engines, Knocking in CI Engines, Octane Number and Cetane Number.	
UNIT III	10 Hours

Gas Turbines- Open and closed cycles for gas turbine, Analysis of basic closed cycle for gas turbine, Thermal efficiency and specific work output, Optimum pressure ratio for maximum cycle output and for maximum cycle efficiency, Effects of regeneration, Re-heating and intercooling on thermal efficiency and work output, Isentropic efficiencies of turbine and compressor, Advantages and disadvantages of gas turbines, Application of gas turbines

UNIT IV	10 Hours

Jet Propulsion - Different types– screw propeller, turbo-jet, turbo-prop, ram jet and pulse jet engines; Operation of rocket engine.

Fundamentals of Compressible Flow: Continuity, momentum and energy equation, control volume, sonic velocity, Mach number and its significance, Mach waves, Mach cone and Mach angle, Static and stagnation states, Stagnation pressure ratio, stagnation temperature ratio, Numerical Problems.

Text Books

1.	Cengel and Boles, "Thermodynamics: Engineering Approach", Tata McGraw-Hill Companies, 2011.
2.	Van Wylen and Sonntag, "Fundamentals of Classical Thermodynamics", John Wiley & Sons Inc., 2002.
3.	P. K. Nag, "Engineering Thermodynamics", Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2011.
4.	Mathur and Sharma, "Internal Combustion Engines", Dhanpat Rai Publications, 2003.
5.	V. Ganesan, "Internal Combustion Engines", Tata McGraw-Hill Publishing Company Limited, New Delhi, India, 2004.
6.	P. L. Ballaney, "Thermal Engineering", Khanna Publishers, Delhi, India, 2012.

Reference Books

1.	Michael J. Moran, Howard N. Shapiro, "Fundamentals of Engineering Thermodynamics", John Wiley & Sons Inc.
2.	P. K. Nag, "Power Plant Engineering", Tata McGraw-Hill , New Delhi, India, 2012.
3.	S. C. Arora and S. Domkundwar, "A course in Power Plant Engineering", Dhanpat Rai & Sons, Delhi, India., 2012.
4.	Arthur H. Lefebvre and Dilip R. Ballal, "GAS Turbine Combustion Alternative Fuels and Emissions" CRC Press: Taylor & Francis Group.
5.	M.M. El Wakil, "Power Plant Engineering", Tata McGraw-Hill Companies, 2002.