Curriculum Structure & Syllabi

(As per National Education Policy 2020)

of

B. Tech.

in

Mechanical Engineering

(w.e.f. 2021-22)

Vision

Mission

Program Educational Objectives

Program Outcomes

Program Specific Outcomes

Overall Credit Structure

Curriculum

Syllabus

Offered By

DEPARTMENT OF MECHANICAL ENGINEERING

M. M. M. UNIVERSITY OF TECHNOLOGY

GORAKHPUR-273 010, UP

August 2022

CURRICULA & SYLLABI
B. Tech. Mechanical Engineering

Vision:
To become an Internationally Acclaimed Department of Higher Learning, Research, Innovation, and Incubation in Mechanical Engineering by 2035.

Mission:
1. To provide quality education to the students in order to make them globally competitive Mechanical Engineers.
2. To enhance the skills of students using modern engineering tools and experimental techniques to solve real life mechanical engineering problems.
3. To make them work in groups with high level of societal, environmental, and professional ethics with the self-learning attitude.
4. To establish linkages with the Industries, R&D organizations, and educational institutions in India and abroad for excellence in teaching, research, and innovation.

Programme Educational Objectives (PEO)

PEO-1: To prepare students in the area of mechanical engineering for successful careers in industries,academia, and research organizations through state-of-the-art education.

PEO-2: To provide students with a sound foundation in science and engineering fundamentals necessary to formulate, analyze and solve mechanical engineering problems and to prepare them for research activities.

PEO-3: To develop ability in the field of machine design, thermal engineering, manufacturing, and industrial engineering so as to design and create novel products, processes, and solutions for the real-life problems.

PEO-4: To inculcate in students professional and ethical attitude, effective communication & teamwork skills, and ability to apply multidisciplinary knowledge to relate mechanical engineering problems to broader environmental and social context.

PEO-5: To engage students in professional development through the self-learning and keep abreast with the state-of-the-art technology needed for a successful professional career

PROGRAM OUTCOMES (POs)

Engineering Graduates will be able to:

1. **Engineering knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
2. **Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.
3. **Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

4. **Conduct investigations of complex problems**: Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
5. **Modern tool usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modelling to complex engineering activities with an understanding of the limitations.
6. **The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues, and the consequent responsibilities relevant to the professional engineering practice.
7. **Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
8. **Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.
9. **Individual and teamwork**: Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
10. **Communication**: Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
11. **Project management and finance**: Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
12. **Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Programme Specific Outcome (PSOs)

PSO 1. Graduate will be able to identify, analyze and solve engineering problems relating to mechanical systems together with allied engineering streams.
PSO 2. Graduates will learn managerial skills and interdisciplinary technologies to work effectively in a team and in a society by following ethical and environmental practices.

Syllabus and Credit Structure for B. Tech. (Mechanical Engineering)

(Session 2021-2022 and onwards)

OVERALL CREDIT STRUCTURE FOR B.TECH. MECHANICAL ENGINEERING PROGRAM

Credit Courses			
Core Courses (CC)**		**Electives Courses (EC)****	
Category	**Min. Credits**	**Category**	**Min. Credits**
Basic Sciences & Maths (BSM)	21	Program Electives (PE)	12
Engineering Fundamentals (EF)	19	Open Electives (OE) (Other Departments)	3
Professional Skill (PS)	4		
Program Core (PC)	64	Humanities & Social Science elective (HSSE)	2
Management (M)	4		
Humanities & Social Science (HSS)	4		
Project (P)	5		
Seminar (S)	2		
Industrial Practice (IP)/ Industrial Elective (IE)	12		
Program link basic science and engineering courses (PLBSE) (To be decided by the department)	17		
Sub-total	**152**	**Sub-total**	**17**
Grand Total	**169**		
**** subjects to be taught for more than one branch may be scheduled both in odd and even semesters.**			
1. Extracurricular Activities Courses (ECA) Two compulsory courses from the following S. No (ii) to (v) non-credit courses: (i) Induction Program (compulsory) (ii) Skill development (iii) Unity and Discipline (NCC or NSS) (iv) Sports, Cultural and Games (v) Personality Development			**Non-Credit**
2. Audit Courses (AC) Two of the Audit Courses are compulsory			**Non-Credit**
3. Industrial Training (Mandatory)			**Non-Credit**

Minor Degree Courses (Optional) from any department	**Credits**
Department Minor (DM) Courses	18-20

DEPARTMENT OF MECHANICAL ENGINEERING
M.M.M. UNIVERSITY OF TECHNOLOGY
GORAKHPUR

Semester wise Credit Structure for B. Tech. (Mechanical Engineering)

Category/Semesters	I	II	III	IV	V	VI	VII	VIII	Total
Basic Sciences & Maths (BSM)	4	8	4	5					**21**
Engineering Fundamentals (EF)	9	6	4						**19**
Professional Skill (PS)	2	2							**4**
Program Core (PC)			9	18	13	12	12		**64**
Management (M)					2	2			**4**
Humanities & Social Science (HSS)	2		2						**4**
Humanities & Social Science Elective (HSSE)	2								**2**
Project (P)						2	3	0/4	**5/9**
Seminar (S)						2			**2**
Industrial Practice (IP)/ Industrial Elective (IE)#								12/8	**12**
Program link basic science and engineering courses (PLBSE)	4	4	2	3	4				**17**
Program Electives (PE)					4	4	4		**12**
Open Electives (OE) (Other Departments)							3		**3**
Total	**23**	**20**	**21**	**26**	**23**	**22**	**22**	**12**	**169**

First Year, Semester I

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-102	Ordinary and Partial Differential Equations	3	1	0	4
2.	EF	BME-102	Engineering Mechanics	3	1	2	5
3.	HSS	BHM-101	Professional Communication	2	0	0	2
4.	PS	BME-101	Technical Art	0	0	4	2
5.	EF	BCS-105	Basic Computer Programming	3	0	2	4
6.	PLBSE	BME-103	Material Science and Engineering	3	0	2	4
7.	HSSE	BHM-104	Human Values & Professional Ethics	2	0	0	2
			Total	**16**	**2**	**10**	**23**

8.	ECA-I		Induction Program	-	-	-	0

First Year, Semester II

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-153	Complex Analysis and Integral Transforms	3	1	0	4
2.	EF	BEE-153	Basic Electrical Engineering	3	0	2	4
3.	BSM	BSM-180	Physics of Applied Materials	3	1	0	4
4.	PS	BME-156	AutoCAD & Refrigeration and Air conditioning	0	0	4	2
5.	EF	BCE-151	Engineering Graphics	0	0	4	2
6.	PLBSE	BME-155	Engineering Thermodynamics	3	1	0	4
			Total	**12**	**3**	**10**	**20**
7.	ECA-II		Induction Program	-	-	-	**0**

Second Year, Semester III

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-203	Operations Research (ME)	3	1	0	4
2.	EF	BME-201	Manufacturing Processes	3	1	0	4
3.	HSS	BHM-112	Industrial Sociology	2	0	0	2
4.	PC	BME-202	Fluid Mechanics	3	1	2	5
5.	PC	BME-203	Kinematics of Machines	3	1	0	4
6.	PLBSE	BME-204	Machine Drawing	0	0	4	2
			Total	**14**	**4**	**6**	**21**
7.	ECA-III			-	-	-	0
8.	AC	AUC-01-AUC-15	Audit Course	1/2	-	-	1/2

Second Year, Semester IV

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	BSM	BSM-252	Numerical Methods	3	1	2	5
2.	PC	BME-251	Mechanics of Solids	3	1	2	5
3.	PC	BME-252	Energy Conversion System	3	0	2	4
4.	PC	BME-253	Dynamics of Machine	3	0	2	4
5.	PC	BME-254	Manufacturing Science	3	0	2	4
6.	PLBSE	BME-255	Measurement & Metrology	2	0	2	3
			Total	**17**	**2**	**12**	**25**
7.	ECA-IV			-	-	-	0
8.	AC	AUC-01-AUC-15	Audit Course	1/2	-	-	½

Third Year, Semester V

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	M	MBA	Engineering & Managerial Economics	2	0	0	2
2.	PC	BME-301	Machine Design-I	3	1	0	4
3.	PC	BME-302	Heat and Mass Transfer	3	1	2	5
4.	PC	BME-303	Additive Manufacturing	3	1	0	4
5.	PE1	BME-326-BME-339	Program Elective-1	3	1	0	4
6.	PLBSE	BME-304	Principle of Industrial Engineering	3	1	0	4
			Total	**17**	**5**	**2**	**23**
7.	ECA-V			-	-	-	0

Third Year, Semester VI

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	M	BHM-302/352	Industrial Management	2	0	0	2
2.	PC	BME-351	Machine Design-II	3	1	0	4
3.	PC	BME-352	Refrigeration & Air Conditioning	3	0	2	4
4.	PC	BME-353	I C Engines	3	0	2	4
5.	PE2	BME-376-389	Program Elective-2	3	1	0	4
6.	P	BME-370	Project Part-I	0	0	4	2
7.	S	BME-380	Seminar	0	0	4	2
			Total	**14**	**2**	**12**	**22**
8.	ECA-VI			-	-	-	0

Final Year, Semester VII

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	PC	BME-401	Automobile Engineering	3	0	2	4
2.	PC	BME-402	Computer Aided Design	3	1	0	4
3.	PC	BME-403	Computer Aided Manufacturing	3	0	2	4
4.	PE3	BME-426-439	Program Elective-3	3	1	0	4
5.	OE	OME-401-405	Open Elective	2	1	0	3
6.	P	BME-440	Project Part-II	0	0	6	3
			Total	**14**	**3**	**10**	**22**
7.	ECA-VII			-	-	-	0

Final Year, Semester VIII

S. N.	Category	Paper Code	Subject	L	T	P	Credit
1.	IP	IME-400	Industrial Practices	0	0	24	12
	Without Industrial Practices (IP)						
2.	MP	BME-480	Minor project	0	0	8	4
	IE	IME-401-IME404	Industrial Elective-I	3	1	0	4
	IE	IME-405-IME408	Industrial Elective-II	3	1	0	4
			Total	**0/6**	**0/2**	**24/8**	**12**

Humanities & Social Science Elective (HSSE)

S.N.	Paper Code	Subject	L	T	P	Credits
1	BHM-104	Human Values and Professional Ethics	2	0	0	2

Program Electives (Mechanical Engineering)

S.N.	Paper Code	Subject	L	T	P	Credits
Program Elective I						
1	BME-326	Design of Mechatronic Systems	3	1	0	4
2	BME-327	Computational Continuum Mechanics	3	1	0	4
3	BME-328	Elements of Solar Energy Conversion	3	1	0	4
4	BME-329	Dynamic Behaviour of Materials	3	1	0	4
Program Elective II						
6	BME-376	Mechanical vibrations	3	1	0	4
7	BME-377	Principles of Machine Tools Design	3	1	0	4
8	BME-378	Total Quality Management	3	1	0	4
9	BME-379	Renewable Energy Technology	3	1	0	4
Program Elective III						
11	BME-426	Power Plant Technologies	3	1	0	4
12	BME-427	Project Management	3	1	0	4
13	BME-428	Advanced Engineering Materials	3	1	0	4
14	BME-429	Hydraulic Machines	3	0	2	4

Industrial Electives (Mechanical Engineering)

S.N.	Paper Code	Subject	L	T	P	Credits
Industrial Electives 1						
1	IME-401	Product Design and Manufacturing	3	1	0	4
2	IME-402	Machinery Fault Diagnosis and Signal Processing	3	1	0	4
3	IME-403	Welding Process	3	1	0	4
4	IME-404	Oil Hydraulics and Pneumatics	3	1	0	4
Industrial Electives 2						
5	IME-405	Non - Metallic Materials	3	1	0	4
6	IME-406	Mechanical Behaviour of Materials	3	1	0	4

7	IME-407	Gas Dynamics and Propulsion	3	1	0	4
8	IME-408	Production Planning & Control	3	1	0	4

List of Open Elective Subjects

S.N.	Category	Paper Code	Subject	L	T	P	Credits
1	OE	OME-401	Manufacturing Processes	2	1	0	3
2	OE	OME-402	Engineering Materials	2	1	0	3
3	OE	OME-403	Quality Management	2	1	0	3

List of Audit Courses (AC)

S.No.	Subjects	Codes
1.	Constitution of India	AUC01
2.	Indian Culture and Heritage	AUC02
3.	Indian Architecture	AUC03
4.	Indian Festivals	AUC04
5.	Vaidic Mathematics	AUC05
6.	Astronomy	AUC06
7.	Arts of India	AUC07
8.	Intellectual Property Right	AUC08
9.	Human Rights	AUC09
10.	Logical Research	AUC10
11.	Professional Ethics	AUC11
12.	Environmental Law	AUC12
13.	Health Law	AUC13
14.	National Cadet Corps	AUC14
15.	Basics of Human Health and preventive medicines	AUC15

**Note: Detailed syllabus of Audit Courses (AC) is attached as Annexure-01.

List of Extra Curricular Activity (ECA) Courses

ECA-II						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-I	ECA-151	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)-I	ECA-171	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-I	ECA-172	2	0
4.	Open to all Branches	ECA	Games & Sports-I	ECA-181	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-I	ECA-182	2	0

ECA-III						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-II	ECA-201	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- II	ECA-221	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-II	ECA-222	2	0
4.	Open to all Branches	ECA	Games & Sports-II	ECA-231	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-II	ECA-232	2	0

ECA-IV						
S. No.	Branch	Category	Subject Name	Subject Code	Hours /Week	Credit
1.	Open to all Branches	ECA	Skill Development-III	ECA-251	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- III	ECA-271	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)- III	ECA-272	2	0
4.	Open to all Branches	ECA	Games & Sports-III	ECA-281	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-III	ECA-282	2	0

ECA-V						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/Week	Credit
1.	Open to all Branches	ECA	Skill Development-IV	ECA-301	2	0
2.	Open to all Branches	ECA	Unity and Discipline (NCC)- IV	ECA-321	2	0
3.	Open to all Branches	ECA	Unity and Discipline (NSS)-IV	ECA-322	2	0
4.	Open to all Branches	ECA	Games & Sports-IV	ECA-331	2	0
5.	Open to all Branches	ECA	Cultural, Art & Literary-IV	ECA-332	2	0
ECA-VI						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit

1.	Open to all Branches	ECA	Skill Development-V	ECA-351	2	0
2.	Open to all Branches	ECA	Games & Sports-V	ECA-381	2	0
3.	Open to all Branches	ECA	Cultural, Art & Literary-V	ECA-382	2	0

ECA-VII						
S. No.	Branch	Category	Subject Name	Subject Code	Hours/ Week	Credit
1.	Open to all Branches	ECA	Skill Development-VI	ECA-401	2	0
2.	Open to all Branches	ECA	Games & Sports-VI	ECA-431	2	0
3.	Open to all Branches	ECA	Cultural, Art & Literary-VI	ECA-432	2	0

**Note: Detailed syllabus of Extra Curricular Activity (ECA) Courses is attached as Annexure-02.

FRAMEWORK FOR THE IMPLEMENTATION OF MOOC COURSES IN B. TECH PROGRAMME

As per the guidelines given by AICTE via GO. No. AICTE/P&AP/SWAYAM/2016 dated 17th August 2016, M. M. M. University of Technology Gorakhpur has decided to implement 20% subjects/courses from MOOCs from SWYAM portal in the curricula of B. Tech programme offered by university from the session 2022-23 onwards. The framework for incorporating the MOOC courses in the curricula of B. Tech programme is given below.

1. The MOOC Courses of Swayam portal will be offered in:
   (a) B. Tech-IInd semester for HSSE Courses of Humanities & Management Science Department.
   (b) B.Tech-IIIrd and IVth semester for Audit Courses (AC) of Humanities & Management Science Department.
   (c) B.Tech-Vth, VIth & VIIth semester as Program Elective (PE) Course of respective Engineering Departments.
   (d) B. Tech-VIIIth semester for Industrial Elective (IE) Course of respective Engineering Departments.
2. It has been indicated in the above GO of AICTE that MOOC Courses of Swayam portal will be announced on 1st June for odd semester and 1st November for the even semester every year. After the announcement of the subjects on Swayam portal, each department of University will identify the subjects against each of the MOCC courses in respective semester from the Swayam portal and send the list of identified subjects to the office of Dean UGS & E after the approval of BOS of respective department. Dean UGS & E will notify the same and notification will be uploaded on the University website well in advance so that students may get registered in the subject in time.
3. Concern department will nominate one of its faculty as a departmental MOOCs Coordinator for each of the MOOC Course and same will be intimated to Dean UGS & E along with the teaching load of the department. The departmental MOOCs Coordinator will be responsible for the registration, assignment submission, term end examination and result of the students who have opted MOOC courses.
4. For the reimbursement of MOOCs registration fee, student will write an application addressed to Dean UGS & E through the concerned Head of Department and departmental MOOCs Coordinator along with the receipt of MOOCs registration fee and admit card/hall ticket. The application of student for the reimbursement of fee will be entertained only if it is recommended by concerned MOOCs Coordinator and Head of Department.
5. Credit will be defined as per clause 6.1.5.5 of B. Tech ordinance for the MOOC Courses on Swayam portal in which credit is not mentioned,
6. If better practical facility is available at virtual lab of different premier institution of national and international importance, then the practical facility of that subject could be availed through the virtual lab. In any practical based subject, if practical lab is not assigned and better practical facility is available on virtual lab then it may be conducted on the virtual lab and one credit will be added through the BOS of concerned department.

7. The evaluation scheme for practical based subjects conducted through virtual lab will be same as the existing evaluation scheme of practical courses of the University.

SYLLABUS

BSM-102		**Ordinary and Partial Differential Equations**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To solve the ordinary differential equations.
2. To solve the partial differential equations using Lagrange and charpit's method.
3. To solve and understand the properties of Bessel`s and Legendre`s differential equation.
4. Application of partial differential equation in real life problems
5. To solve Wave, Heat and Laplace equation upto two dimensions.
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Ordinary Differential Equations I: Linear differential equations with constant coefficients ($n^{th} order$), complementary function and particular integral. Simultaneous linear differential equations, solution of second order differential equations by changing dependent and independent variables, Method of variation of parameters, Applications of differential equations to engineering problems

UNIT-II 9

Ordinary Differential Equations II: Series solution of second order differential equations with variable coefficient (Frobeneous method). Bessel and Legendre equations and their series solutions, Properties of Bessel function and Legendre polynomials.

UNIT-III 9

Partial Differential equations I: Partial differential equations of the first order, Lagrange's solution, Charpit's general method of solution, Partial differential equations of the second order: Constant coefficient and reducible to constant coefficient, Classification of linear partial differential equations of second order.

UNIT-IV 9

Partial Differential Equations II: Method of separation of variables for solving partial differential equations, Wave equation up to two-dimensions, Laplace equation in two dimensions, Heat conduction equations up to two dimensions

Text & Reference Books:

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers
2. Erwin kreyszig: Advanced Engineering Mathematics, John Wiley & Sons.

3. R. K. Jain and Iyenger: Advanced Engineering Mathematics, Narosa Publications.
4. B.V. Ramana: Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd.
5. M.D. Raisinghania, Ordinary and Partial Differential Equations. S Chand Publications.

BME-102 ENGINEERING MECHANICS

Course category : Engineering Fundamentals (EF)

Pre-requisite Subject : NIL

Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 2

Number of Credits : 5

Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor test and One Major Theory & Practical Examination

Course Objectives : This course introduces basic concepts of force and its applications in solving engineering problems based on the various laws in statics and dynamics. This course also introduces the applications of force in deformable bodies.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the laws of mechanics and two-dimensional force systems, equivalent force system, types of friction and its application in belt drives.
2. The ability to draw shear force and bending moment diagrams for beams under various types of loads and calculate the forces in truss.
3. To determine centroid of plane composite surfaces, moment of inertia of composite bodies and mass moment of inertia of simple and complex shape bodies.
4. The ability to understand the relationships of kinematic quantities of rigid bodies involving linear, curvilinear, and angular motions
5. The ability to understand the applications of force in kinetics of rigid bodies involving general motion and application of D'Alembert's principles.
6. Understand the effects of deformation, types of stress generation and relationships among elastic constants, stresses in beams of different cross-sections in simple bending as well as stresses in circular shafts under pure torsion.

Topics Covered

UNIT-I 9

Two-dimensional Force Systems

Basic Concepts, Laws of Mechanics, System of forces, Varignon's theorem, Transfer of a force to parallel position, Equivalent force system, Resultant of concurrent and non-concurrent force system, Free body diagrams, Equations of equilibrium, Applications

Friction and Applications

Introduction, Dry friction, rolling friction, Fluid friction, Laws of Coulomb friction, Angle of friction, Cone of friction, Angle of repose, Equilibrium of bodies involving dry friction, Bodies resting on rough horizontal and inclined planes, Belt friction-Flat and V belt, Ratio of driving tensions for flat belt, Centrifugal tension, Initial tension, Condition of maximum power Transmission.

UNIT-II 9

Beams

Introduction, Types of supports, Beams classification, Free body diagram, Shear force and bending moment, Analysis of beams, Shear force and bending moment diagrams for concentrated and uniformly distributed loads

Trusses: Simple Trusses, Zero force members, Method of Sections, Method of Joints

Properties of Plane Surfaces

First moment of area, Centroid of a plane and composite bodies joined by different surfaces, Surface of revolution and volume of revolution, Moment of Inertia of area, Parallel axis theorem, Perpendicular axis theorem, Moment of inertia of composite bodies, Principal axes and principal moments of inertia, Mass moment of inertia of a thin rod, thin uniform plate, thin rectangular sheet, circular ring, thin disc, solid cylinder, sphere, and cone about their axis of symmetry

UNIT-III 9

Kinematics of a rigid body

Introduction, Plane motion of a rigid body, Linear motion, Translation of a point with constant acceleration, Equation of motion due to gravity, Angular motion, Relation between angular displacement and angular velocity with constant angular acceleration, Curvilinear motion of a particle, Normal and tangential acceleration, General plane motion, Instantaneous centre of rotation

Kinetics of rigid body

Introduction, Laws of motion, Kinetics of rigid bodies, Motion on inclined rough surface, Analysis of lift motion, Motion of two bodies connected by a string, Pure rotation of a rigid body, General motion of a rigid body, Work and energy, Linear and angular momentum, D'Alembert's principle.

UNIT-IV 9

Mechanics of Deformable Bodies

Introduction, Normal and shear stresses, Poisson's ratio, Elastic constants and their relationships, Generalized Hooke's law, Deformation of bars of uniform and varying cross-sections, Strain energyin members due to static loading, Statically determinate problems, Stress-strain diagrams for ductile and brittle materials; Pure Bending of beams, Assumptions, Simple bending theory, Stress of beams of different cross sections ; Torsion of Circular shafts, Shear stress due to torsion, Polar modulus, Power transmission

EXPERIMENTS

Note: Minimum Eight experiments are to be performed

1. Tensile strength test on universal testing machine
2. Compressive strength test on universal testing machine
3. Impact test on Impact testing machine
4. Torsion test of a rod on torsion testing machine
5. Experiments on friction between belt and pulley
6. Experiments on flywheel
7. Friction experiments on inclined plane/Screw jack
8. Experiments on bending of simple supported and cantilever beams

9. Statics experiments on equilibrium
10. Experiment on moment of inertia

Text & Reference books:

1. Engineering Mechanics: Statics and dynamics - I.H. Shames (PHI)
2. Vector Mechanics for Engineers, Vol I - Statics, Vol II – Dynamics, F. P. Beer and E. R. Johnston (Tata McGraw Hill).
3. J. L. Meriam and L. G. Kraige, Engineering Mechanics, Vol I – Statics, Vol II –Dynamics, J. L. Meriam and L. G. Kraige (John Wiley).
4. Engineering Mechanics: Principles of Statics and Dynamics R. C. Hibbler, (Pearson Press).
5. Engineering Mechanics -S S Bhavikatti (New Age International)
6. Engineering Mechanics - D S Kumar (Katson)
7. Engineering Mechanics, M. K. Harbola, (Cengage Learning)
8. Engineering Mechanics - H D Ram and A K Chauhan (McGraw Hill)
9. Engineering Mechanics- R. K. Bansal (Laxmi Publications)

BHM-101/151 PROFESSIONAL COMMUNICATION

Course Category: Humanities & Social Science (HSS)
Pre-requisite Subject: None
Contact hours/week: 02
No of Credits: Lecture: 2, Tutorial: 0, Practical: 0 (Total Credit: 02)
Course Assessment Methods: Continuous Assessment through Attendance, Home Assignments, Two Minor tests and one Major Theory Examination.

Course Objective: The course aims:

To sensitize the students to understand the role & importance of communication for personal & professional success and enable learners to exhibit knowledge, skills, and judgment in and around human communication that facilitate their ability to work collaboratively with others in an interpersonal environment.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Use of various facets of communication skills, such as, Reading, Writing, Listening and speaking skills.
2. To identify, formulate and solve the real-life problems with positive attitude.
3. To inculcate the habit of learning and developing the communication and soft skills by practice.
4. To create an amicable ambience to make them learn the different part of English language with the correction of the language.
5. Enhancing word power by counselling scientific literature.
6. Focusing on effortless speaking and writing.

UNIT – I VERBAL COMMUNICATION: 6

Received Pronunciation; how to activate passive vocabulary; Technical/non-technical and Business Presentations; questioning and answer skills; soft skills for professionals; role of body postures,

movements, gestures, facial expressions, dress in effective communication; Information/ Desk/ Front Office/ Telephone conversation; how to face an interview/press conference; Group discussions, debates, elocution.

UNIT – II: READING COMPREHENSION **6**

Skimming and Scanning; factual and inferential comprehension; prediction; guessing meaning of words from context; word reference; use and interpretation of visuals and graphics in technical writing.

UNIT – III: WRITTEN COMMUNICATION: **6**

Note Making and Note Taking; summarizing; invitation, advertisement, agenda, notice and memos; official and commercial letters; job application; resume and curriculum vitae; utility, technical, project and enquiry reports; paragraph writing: General – Specific, Problem – Solution, Process – Description, Data – Comment.

UNIT – IV: SHORT ESSAYS: **6**

Description and Argument; comparison and contrast; illustration; using graphics in writing: tables and charts, diagrams and flow charts, maps and plans, graphs; how to write research paper; skills of editing and revising; skills of referencing; what is a bibliography and how to prepare it.

Text and Reference Books

1. Bansal, R.K. & Harrison J.B., (1972) *Spoken English*, Orient Longman, India.
2. Chauhan, Narender Kr. & Singh, Sudhir N., (2013) *Formal Letters*, Pankaj Publication International, New Delhi.
3. Chhabra T.N., (2019) *Business Communication*, Sun India Publication, New Delhi.
4. Dixon Robert J., (1986) *Complete Course in English*, Prentice Hall of India, New Delhi.
5. Jones, Daniel., (2012) *Cambridge English Pronouncing Dictionary*, 18th Edition, Paperback, CUP, India.
6. Lewis, Norman, (2015) *Word Power Made Easy*, Penguin India.

BME 101/BME 151		**Technical Art**
Course Category	:	Professional Skill (PS)
Pre-requisite Subject	:	NIL
Contact Hours/Week	:	Lecture: 0, Tutorial: 0, Practical: 04
Number of Credits	:	02
Course Assessment Method	:	Continuous assessment through one Viva-voce, Practical work/record, attendance, and Major Practical Examination
Course Objective		This course introduces basic concepts of various manufacturing processes and their applications in production of complex shape and size products based on the concepts of forming, welding, casting and machining.
Course Outcomes	:	After completion of this course the students are expected to be able to demonstrate following knowledge, skills, and attitudes

1. Understand the importance, materials, applications, and safety in different shops for the development of a product/component.
2. The knowledge of tools and processes used in carpentry and foundry shops for the development of products through the casting process.
3. The knowledge of forming process will develop skills for producing products using different tools and processes in the black smithy and sheet metal shops.
4. The knowledge and practical skill of various welding processes and their application.
5. The knowledge and practical skill of various machining processes.
6. The knowledge of non-conventional machining will develop the ability to produce various products.

Topics Covered (Make at least one job in each shop):

Introduction:

i. Need for and importance of Technical Arts.
ii. Shop Layout: Concept and Importance.
iii. Mechanical properties of metals& non-metals.
iv. Ferrous Metals and alloys- composition and applications.
v. Non-Ferrous Metals and alloys- composition and applications.
vi. Safety precautions at shopfloor.

Carpentry Shop:

i. Draw layout of carpentry shop
ii. Study of tools & operations and carpentry joints.
iii. Preparation of half-lap corner joint, mortise &Tennon joint
iv. Simple exercise on woodworking lathe

Fitting Shop:

i. Layout of fitting shop
ii. Study of tools & operations
iii. Simple exercises involving fitting work
iv. Simple exercises involving drilling/tapping/die

Black Smithy Shop:

i. Layout of Smithy Shop
ii. Study of tools & operations
iii. Hot and cold working
iv. Simple exercises based on black smithy operations such as upsetting, drawing down, punching, bending, fullering & swaging.

Welding Shop:

i. Layout of welding shop
ii. Study of equipment of gas welding & arc welding
iii. Preparation of simple butt and lap welded joints.
iv. Oxy-acetylene flame cutting
v. Study of welding defects.

Sheet-metal Shop:

i. Layout of Sheet metal shop

ii. Metals used in sheet metal work such as Galvanized iron, Copper sheet, Aluminum sheet
iii. Study of tools & operations
iv. Fabrication of Funnel, toolbox, tray, electric panel box etc.

Machine Shop:

i. Layout of Machine shop
ii. Study of Lathe, Drilling, Shaper, Planer and Milling Machines and commonly done operations on these machines
iii. Single point and Multi-point Cutting tools
iv. Making a job on lathe involving plane turning step turning, taper turning, and threading operations

Foundry Shop:

i. Layout of foundry shop
ii. Study of tools & operations
iii. Study on pattern allowances
iv. To prepare a Mould with the use of a core and cast it
v. Study of casting defects

Advanced Machining Lab:

i. Layout of the Advanced Machining Lab.
ii. Study about Computerized Numerically Controlled and Non- conventional machining processes.
iii. Study of Flexible Manufacturing System.
iv. Simple experiments on CNC turning and milling.

Project:

Each group will fabricate a simple utility project using above different shops.

Text and Reference books:

1. Fundamental of Modern Manufacturing: Materials, Processes and Systems: M. P. Groover (John Wiley)
2. Fundamental of Manufacturing Processes: G. K. Lal and S. K. Choudhary (Narosa).
3. Manufacturing technology – Machine Tools: P. N. Rao (TMH)
4. Manufacturing technology – Foundry, Forming and Welding: P. N. Rao (TMH).
5. Manufacturing Engineering & Technology: Kalpakjian (Pearson)
6. Advanced Machining Processes: V. K. Jain (Allied Publishers)
7. Manufacturing Science: A. Ghosh and A.K. Mallik (East- West Press).
8. Workshop Technology Vol-I: B. S. Raghuvanshi (Dhanpat Rai and Sons)
9. Workshop Technology Vol-II: B. S. Raghubanshi (Dhanpat Rai and Sons)

BCS-105 Basic Computer Programming

Course category : Engineering Fundamental (EF)
Pre-requisite Subject : NIL
Contact hours/week : Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits : 4

Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work record, viva-voce, two minor tests and one major Theory and Practical Examination.
Course Objectives	:	This course helps the students in gaining the knowledge to write simple C language applications, mathematical and engineering problems. This course helps to undertake future courses that assume this programming language as a background in computer programming, read and understand C programs. 1. Discuss basic theory and practice of programming 2. Design and implement practical programs using C language
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Use compiler and feel comfortable with Windows environment
2. Identify and fix common C errors
3. Upon completion of the course, the students will be able to:
4. Write, compile and debug programs in C language.
5. Use different data types in a computer program.
6. Design programs involving decision structures, loops, arrays and functions

Topics Covered

UNIT-I 9

Basics of Computer: Introduction to Digital Computer, Basic Operations of Computer, Functional Components of Computer, Classification of Computers. Introduction to Operating System: DOS, Windows, Linux, Function, Services and Types. Basics of Programming: Approaches to Problem Solving, Concept of Algorithm and Flow Charts, Types of Computer Languages: Machine Language, Assembly Language and High-Level Language, Concept of Assembler, Compiler, Loader and Linker.

UNIT-II 9

Standard I/O in "C", Fundamental Data Types: char, int, short, long, float, double, long double. Storage Classes: Automatic, Register, Static, External. Operators and Expressions: Using Numeric and Relational Operators, Mixed Operands and Type Conversion, Logical Operators, Bit Operations, Operator Precedence and Associativity. C Conditional Program Execution: Applying if and Switch Statements, Nesting if and else, Restrictions on switch Values, Use of Break. Program Loops and Iteration: Uses of while, do and for Loops, Multiple Loop Variables, Assignment Operators, Use of break and continue keywords.

UNIT-III 9

Functions: Designing Structured Programs, Functions in C, User Defined and Standard Functions, Formal vs. Actual Arguments, Function Category, Function Prototype, Parameter Passing, Recursive Functions. Arrays: One Dimensional, Multidimensional Array and their Applications, Declaration and Manipulation of Arrays. Strings: String Variable, String Handling Functions, Array of Strings. Storage Classes revisited.

UNIT-IV 9

Pointers: Pointer Variable and its Importance, Pointer Arithmetic and Scale Factor, Compatibility, Dereferencing, L value and R-Value, Pointers and Arrays. Structure and

Union: Declaration and Initialization of Structures, Structure and array, Structure Pointers, Declaration and Initialization of union, Union vs Structure. Implement the concept of simultaneous linear equations, Bisection, Newton Raphson, Interpolation, Trapezoidal and Simpson methods.

EXPERIMENTS

1. Write a program that finds whether a given number is even or odd.
2. Write a program that tells whether a given year is a leap year or not.
3. Write a program that accepts marks of five subjects and finds percentage and prints grades according to the following criteria:
    a. Between 90-100%----------Print "A"
    b. 80-90%----------Print "B"
    c. 60-80%----------Print "C"
    d. Below 60%----------Print "D"
4. Write a program that takes two operands and one operator from the user and perform the operation and prints the result by using Switch statement.
5. Write a program to print sum of even and odd numbers from 1 to N numbers.
6. Write a program to print the Fibonacci series.
7. Write a program to check whether the entered number is prime or not.
8. Write a program to find the reverse of a number.
9. Write a program to print Armstrong Numbers from 1 to 100.
10. Write a program to convert binary number into decimal number and vice versa.
11. Write a program that simply takes elements of array from user and finds sum of these elements.
12. Write a program that inputs two arrays and saves sum of corresponding elements of these arrays in a third array and prints them.
13. Write a program to find the minimum and maximum element of the array.
14. Write a program to implement the concept of simultaneous linear equations.
15. Write programs to implement the Bisection, Newton Raphson, Interpolation, Trapezoidal and Simpson methods.

Text & Reference books:

1. Jeri R. Hanly and Elliot B. Koffman, Problem Solving and Program Design in C, 7th Edition, Pearson.
2. Schildt, Herbert, Complete Reference with C, Tata McGraw Hill Publication.
3. Kerninghan and Ritchie, The C programming Language, 2nd Edition, Prentice Hall.

BME-103	**MATERIAL SCIENCE AND ENGINEERING**
Course category	: Program Link Basic Science and Engineering Courses (PLBSE)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through attendance, home assignments, quizzes, practical work record, viva-voce, two minor tests and one major Theory and Practical examination.

Course Objectives : This course introduces basic concepts of material and their applications for engineering problems based on the concepts of crystallography, mechanical properties and testing. This course also introduces the concept of microstructural examination and various heat treatment processes.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the importance of various materials with their basic concepts including crystallography and imperfections.
2. The understanding of the various mechanical properties and testing by different testing methods suchas strength, hardness, fatigue, NDT, etc.
3. The knowledge of various microstructural examinations and Phase diagrams.
4. The knowledge of different ferrous and non-ferrous metals and their applications.
5. The knowledge of different heat treatment processes, TTT diagram, and their application.
6. The knowledge of different concepts regarding smart materials and electrical, magnetic, electronic properties of materials.

Topics Covered

UNIT-I 9

Introduction

Historical perspective, importance of materials, Crystallography and imperfections: Concept of unitcell, space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices, X-ray crystallography techniques, imperfections, Defects & Dislocations in solids

UNIT-II 9

Mechanical Properties and Testing

Stress strain diagram, Ductile and brittle materials, stress Vs strength, toughness, hardness, fracture,fatigue and creep. Testing, such as Strength testing, Hardness testing, Impact tests, Fatigue testing Creep testing, Non-destructive testing (NDT). Performance of materials in service: Brief theoretical consideration of fracture, fatigue, and corrosion and its control.

Micro Structural Examination

Microscope principle and methods, Preparation of samples and microstructure exam and grain size determination, comparative study of microstructure of various metals and alloys, such as Mild steel,CI, Brass.

Phase Diagram and Equilibrium Diagram

Unary and Binary diagrams, Phase rules, Types of equilibrium diagrams: solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.

UNIT-III 9

Ferrous & Non-ferrous materials

Iron and steel manufacture, furnaces, various types of carbon steels, alloy steels and cast irons, its properties and uses. 3 Heat Treatment: various types of heat treatment, such as Annealing, Normalizing, Quenching, Tempering and Case hardening. Time Temperature Transformation (TTT) diagrams.

Non-Ferrous metals and alloys

Non-ferrous metals, such as Cu, Al, Zn, Cr, Ni etc. and its applications

UNIT-IV 9

Magnetic properties

Concept of magnetism- Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials, Magnetic Storages.

Electrical Properties

Energy band, concept of conductor, insulator and semiconductor. Intrinsic and extrinsic semi- conductors, P-n junction and transistors, Basic devices and their applications. diffusion of Solid, Super conductivity and its applications, Messier effect. Type I & II superconductors. High Temp. superconductors, Brief description of other material such as optical and thermal materials, Composite Materials and its uses. Smart materials & Nanomaterials and their potential applications

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following:

1. Tensile test on universal testing machine
2. Compressive on universal testing machine
3. Torsion test of a rod on torsion testing machine
4. Creep test on creep testing machine
5. Fatigue test on fatigue testing machine
6. Hardness testing of given specimen on Vicker/Brinell/Rockwell hardness testing machine
7. Determination of deflection of cantilever under point/uniformly distributed loading
8. Determination of deflection of beam under point/uniformly distributed loading
9. Study of corrosion and its effects.
10. Comparative study of microstructures of different specimens of different materials (mild steel, gray C.I., brass, copper etc.)
11. Study of heat treatment processes such as annealing, normalizing, quenching, case hardening andcomparison of hardness before and after heat treatment.
12. Study of nondestructive testing methods such as ultrasonic flaw detector, magnetic flaw detectorand eddy current testing machine

Text & Reference books:

1. Material Science and Engineering – Smith, Hashemi and Prakash (Tata McGraw Hill)
2. Material Science- Narula (Tata McGraw Hill)
3. Material Science for Engineering Students- Fischer (Academic Press)
4. Material Science & Engineering - Van Vlash (John Wiley & Sons)
5. Elements of Material Science & Engineering -W.D. Callister (Wiley India Pvt. Ltd.)
6. Technology of Engineering Materials- Philip and Bolton (Butterworth-Heinamann)
7. Material Science -V. Raghvan (Prentice Hall of India)
8. Elements of Material Science & Engineering- Van Vlack (Pearson

BHM-104/154 HUMAN VALUES & PROFESSIONAL ETHICS

Course Category: Humanities & Social Science Elective (HSSE)

Pre-requisite Subject: None
Contact hours/week: 2 hours per week
No of Credits: Lecture: 2, Tutorial:0, Practical: 0
Course Assessment Methods: Continuous assessment through attendance, home assignments, quizzes and two Minor Test, one Major Theory Examination.

Course Objective: The Course aims:

To give basic insights and inputs to the students to inculcate Human values to grow as a responsible human being with holistic personality and enable them to understand and appreciate versatility and universality of human values and their pivotal role in professional field.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1) To create conducive environment for professionals to grow as good and responsible human beings imbibing values and ethics.
2) Understanding the significance of environment.
3) Developing humanitarian outlook.
4) Able to understand nature of the individual and legal aspects of environment.
5) Understanding g major ideas, values, beliefs, and experiences.
6) These issues will help to sensitise students to be broader towards the social, cultural and human issues involved in social changes.

UNIT-I **6**

Origin, Meaning, and Definition of Value, Types of Values, Individual Value, Family Value, Societal Value, Human Value, Value in Education System, Understanding Happiness and Prosperity, Self-Exploration and Natural Acceptance.

UNIT-II **6**

Harmony in family, Harmony in Society, Values Leading to Harmony, Creating a world family, Harmony in Nature, Environment and Sustainable Developmental, Legal aspects of Environment, Holistic Perspectives of Values, Existence and Co-existence.

UNIT-III **6**

Origin, Meaning and Definition of Ethics, Ethics: The science of the Morality of The Art of Correct Living, Ethics in Human Acts, Ethics and Religion, Ethical Norms and Laws, Ethics in Literature, Ethics in Science and Technology.

UNIT-IV **6**

Ethical Approaches: Theistic Approach, Atheistic Approach, General and Special Ethics, Professional Ethics: Ethics at work-place, Ethics as Skill, Values and Ethics, Ethics with Value Education, Managerial and Business & Corporate Ethics, Corporate Social Responsibilities.

Text and References Books:

1. Bangaria, G. P et.al, (2010) *A foundation course in Human Values and Professional Ethics*, Excel books.
2. Govindrajan, M. (2013) *Professional Ethics and Human Values*, Eastern Economy Edition.

3. Naagrazan, R.S. (2018) *Textbook on Professional Ethics and Human Values*, New age International. Misra, Anuranjan and Shukla, Dr. R.K., *Human values and Professional Ethics*.
4. Fernando, A. C., (2009) *Business Ethics: An Indian Perspective*, Pearson, India.

BSM-153		**Complex Analysis and Integral Transforms**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The course is aimed to develop the basic mathematical skills of engineering students that are imperative for effective understanding of engineering subjects.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Prove basic results in complex analysis.
2. Establish the capacity for mathematical reasoning through analysing, proving, and explaining concepts from complex analysis.
3. Solve the problems using complex analysis techniques applied to different situations in engineering contexts.
4. Use of Laplace Transform to solve the differential equation.
5. Use of Fourier transforms, and Z transforms to solve the differential equation.
6. To inculcate the habit of mathematical thinking and lifelong learning.

Topics Covered

UNIT-I 9

Functions of Complex Variable I:

Complex differentiability, Cauchy-Riemann equations, Analytic functions, Harmonic functions, Harmonic conjugates, Cauchy-Integral Theorem, Cauchy-Integral formula, Cauchy's integral formula for higher derivatives.

UNIT-II 9

Functions of Complex Variable II:

Taylor's Series and Laurent Series, Zero's and Singularities of functions, Removable singularity, Poles and essential singularities, Residues, Cauchy's residue theorem., Residue theorem, Evaluation of the real integrals of the type $\int_0^{2\pi} f(\cos\theta, \sin\theta)d\theta$ *and* $\int_{-\infty}^{+\infty} f(x)dx$.

UNIT-III 9

Integral Transform I:

Laplace Transform Laplace transform, Existence theorem, Laplace transforms of derivatives and integrals, Initial and final value theorems, Unit step function, Dirac- delta function. Laplace transform of periodic function, Impulse function. Inverse Laplace transform, Convolution theorem, Application to solve simple linear and simultaneous differential equations.

UNIT-IV 9

Integral Transform II:

Fourier integral, Complex Fourier transform, Inverse Transforms, Convolution Theorems, Fourier sine and cosine transform, Applications of Fourier transform to simple one-dimensional heat transfer equation, wave equation. Z- transform and its application to solve difference equations.

Text & Reference Books:

1. B.S. Grewal: Higher Engineering Mathematics; Khanna Publishers.
2. Jain, Iyenger and Jain: Advanced Engineering Mathematics, Tata McGraw Hill Education Pvt. Ltd., New Delhi
3. James W. Brown & R. V. Churchill: Complex variables and applications, Mcgraw-Hill Asia
4. Debanth L. and Bhatta D., "Integral Transforms and Their Applications", 2nd edition, Taylor and Francis Group, 2007.
5. Sneddon I. N. Fourier Transforms, Dover Publication, 2010.

BEE-153 **Basic Electrical Engineering**

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce, two minor tests and one major theory & practical examination.
Course Objectives	:	1. To demonstrate and understand the basic knowledge of electrical quantities such as current, voltage, power, energy, and frequency to understand the impact of technology in a global and societal context. 2. To demonstrate and understand the basic concepts of analysis of simple DC and AC circuits used in electrical engineering and apply the basic concepts in Electrical engineering for multi-disciplinary tasks.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the basic properties of electrical elements, and solve problem based on basic electrical circuits & DC network theorems.
2. Understand the fundamental behavior of AC circuits and solve AC circuit problems.

3. Apply the knowledge gained to explain the behavior of the circuit at series & parallel resonance of circuit & the effect of resonance.
4. Classify different electrical measuring equipment's and understanding their principles.
5. Understand the basic concepts of magnetic circuits.
6. Explain construction and working principle of transformer.

Topics Covered

UNIT-I 9

D C Circuit Analysis and Network Theorems:

Circuit Concepts: Concepts of network, Active and passive elements, Voltage and current sources, Concept of linearity and linear network, Unilateral and bilateral elements, R, L and C as linear elements, Source transformation, Kirchhoff's laws, Loop and nodal methods of analysis, Star-delta transformation, Network theorems: Superposition theorem, Thevenin's theorem, Norton's theorem, Maximum Power Transfer theorem.

UNIT-II 9

Steady- State Analysis of Single-Phase AC Circuits:

AC fundamentals: Sinusoidal, square, and triangular waveforms – Average and effective values, Form and peak factors, Concept of phasor, phasor representation of sinusoidally varying voltage and current, Analysis of series, parallel and series-parallel RLC Circuits, Resonance in series and Parallel circuit Three Phase AC Circuits: Three phase system-its necessity and advantages, Star and delta connections, Balanced supply and balanced load, Line and phase voltage/current relations, three-phase power, and its measurement

UNIT-III 9

Measuring Instruments & Magnetic Circuit:

Types of instruments, Construction and working principles of PMMC and Moving Iron type voltmeters & ammeters, Use of shunts and multipliers. Magnetic circuit, concepts, analogy between electric & magnetic circuits, B-H curve, Hysteresis, and eddy current losses.

UNIT-IV 9

Single-Phase Transformers:

Single Phase Transformer: Principle of operation, Construction, EMF equation, Power losses, Efficiency, O.C & S.C Test and Introduction to auto transformer.

EXPERIMENTS

1. Verification of Kirchhoff's Law.
2. Verification of Norton's Theorem.
3. Verification of Thevenin's Theorem.
4. Verification of Superposition Theorem.
5. Verification of Maximum Power Transfer Theorem.
6. Verification of Series R-L-C circuit.
7. Verification of Parallel R-L-C circuit.
8. Measurement of Power and Power factor of three phase inductive load by two wattmeter method.
9. To perform O.C. and S.C. test of a single-phase transformer.

Text & Reference books:

1. Fundamentals of Electric Circuits, C.K. Alexander and M.N.O. Sadiku; TATA McGraw-Hill.
2. Principles of Electrical Engineering, V. Del Toro; Prentice Hall International.
3. Electrical and Electronics Technology, Edward Hughes; Pearson.
4. Basic Electrical Engineering, D P Kothari, I.J. Nagarath; Tata McGraw Hill
5. Electrical Technology, B. L. Thareja and A. K. Thareja; S. Chand.

BSM-180 **PHYSICS OF APPLIED MATERIALS**

Course category : Basic Sciences & Maths (BSM)

Pre-requisite Subject : Physics at 12th standard

Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 0

Number of Credits : 4

Course Assessment methods Continuous assessment through tutorials, attendance, home assignments, quizzes, Two Minor tests and One Major Theory.

Course Objective : Understanding of the principle and concepts of Crystallography, Quantum Mechanics, Basic principles of electricity and magnetism, Maxwell's Equations, of and Advanced Materials for their applications Engineering.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Basics of crystallography and its applications in Engineering.
2. Quantum Mechanics and its application to understand material properties at atomic level.
3. Basic principles of electricity and magnetism applied in Engineering.
4. Maxwell's equations of electromagnetic theory and its application in engineering.
5. Basic principles of semiconducting materials and its application in engineering.
6. Basic Principles of advanced materials and their applications in Engineering.

Topics Covered

UNIT-I 9

Crystal Structures and X-ray Diffraction:

Space lattice, basis, Unit cell, Lattice parameter, Seven crystal systems and Fourteen Bravais lattices, Crystal-System Structure, Packing factor (cubic, body and face), Lattice planes and Miller Indices, Diffraction of X-rays by crystal, Bragg's Law, Bragg's spectrometer.

UNIT-II 9

Quantum Mechanics:

De Broglie waves and Group velocity concept, Uncertainty principle and its application, Davisson-Germer experiment, Derivation of Schrodinger equation for time independent and time dependent cases. Postulates of quantum mechanics, Significance of wave function, Application of Schrodinger wave equation for a free particle; Particle in a box (one dimensional).

UNIT-III 9

Electrodynamics –I: Basic concepts of Gauss's law, Ampere's law and faradays law of electromagnetic induction. Correction of Ampere's law by Maxwell (concept of displacement current), Maxwell's equation, transformation from integral form to differential form, physical significance of each equation

Electrodynamics –II: Maxwell's equation in free space, velocity of electromagnetic wave, transverse character of the wave and orthogonality of E, H and k vectors, Maxwell's equations in dielectric and conducting medium, velocity of e. m. wave, comparison with free space, penetration depth.

UNIT-IV 9

Physics of Advanced Materials

Semiconducting Materials**,** Concept of energy bands in solids, concept of direct and indirect band gap, Carrier concentration and conductivity in semiconductors, Optoelectronic Materials, Superconducting Materials**,** Temperature dependence of resistivity in superconducting materials, Effect of magnetic field (Meissner effect), Type I and Type II superconductors, BCS theory (Qualitative), Introduction of nanoscience and technology.

Text & Reference Books:

1. Introduction to Solid State Physics- Kittel, 7th edition, Wiley Eastern Ltd.
2. Solid State Physics - S. O. Pillai, 5th edition, New Age International.
3. Introduction to Electrodynamics- David J. Griffiths Pearson, New International Edition
4. Quantum Physics by H. C. Verma, 3rd Edition, Surya Publication Ghaziabad,
5. Semiconductor Devices and Application - S.M. Sze, Wiley
6. Introduction to Nano Technology - Poole Owens, Wiley India
7. Engineering Physics by B. K. Pandey and S. Chaturvedi, 2e Cengage Learning Pvt. Limited, India

BME 156 **AUTOCAD & REFRIGERATION AND AIR CONDITIONING**

Course category : Professional Skill (PS)

Pre-requisite Subject : NIL

Contact hours/week : Lecture: 0, Tutorial: 0, Practical: 4

Number of Credits : 2

Course Assessment methods Continuous assessment through three Viva voce, Practical work/record, attendance, and Major Practical Examination

Course Objectives :

(i) To introduce the principles of air conditioning and refrigeration. The course will provide a basic understanding of the types of air conditioning and refrigeration systems, applications, and operating principles.

(ii) To use AutoCAD as a drafting and design tool used in the mechanical design and manufacturing industries. Create, manipulate, and edit 2D drawings and figures.

Course Outcomes : After completion of this course the students are expected to be able to

1. Understand the different types of commands used in AutoCAD.
2. Candidate should be able to draw different types of drawing views in 2D and 3D.
3. Candidate should be able to understand the significance of AutoCAD.
4. Understand the elementary knowledge of refrigeration and air conditioning systems.
5. Understand the domestic applications of refrigeration and air conditioning systems
6. Understand the maintenance of various components of refrigeration and air conditioning systems.

Topics Covered

Automatic Computer Aided Design (Auto CAD)

Introduction of AutoCAD, Components of AutoCAD, Cartesian Coordinate System - Absolute & Relative type, Function keys, Different types of commands, Introduction of different types of modelling – Wire modelling, Surface modelling and solid modelling. Dimensioning and Text writing, Introduction of different angle of projections, orthographic projections, Isometric views.

- To study and understand the different components of AutoCAD.
- To understand and use the different draw commands in AutoCAD.
- To understand and use the different modify commands in AutoCAD.
- To understand and use the display and editing commands in AutoCAD.
- To write the text and dimensions by using AutoCAD.
- To draw the different two-dimensional Figures such as rectangle, circle, ellipse, arc, polygon, and polyline etc. in AutoCAD.
- Draw the Two Dimensional vies of given Figures by using AutoCAD.
- Draw the Isometric view of Object by using AutoCAD.

Refrigeration & Air Conditioning systems

Introduction to refrigeration system, Unit of refrigeration, Refrigeration effect, Coefficient of Performance (COP), Components of refrigeration & air conditioning system, Psychrometric properties

- To determine refrigeration effect and COP using vapour compression refrigeration test rig
- To find out various psychrometric properties of atmospheric air using psychrometric chart
- To study various expansion devices used in RAC systems
- To study domestic refrigerator
- To study window air conditioner
- Leak detection test and gas charging in refrigerator
- Dismantling of Hermetic sealed compressors used in RAC systems
- Servicing and maintenance of different components of window air conditioner

Text & Reference books:

1. Engineering Graphics with AutoCAD- D.M. Kulkarni, A. P. Rastogi, A K Sarkar (PHI Publication).
2. Engineering Graphics and Design- P.S.Gill (S.K. Kataria and Sons , New Delhi)

3. A Textbook of Engineering Drawing – Dr. R. K. Dhawan, 3rd Edition (S. Chand Publication, New Delhi).
4. Engineering Drawing +AutoCAD -K. Venugopal and V Prabhu Raja, New Age International Publisher.
5. Refrigeration and Air conditioning - Manohar Prasad (New Age International (P) Ltd)
6. Refrigeration and Air conditioning - C.P Arora (Tata McGraw Hill).
7. Refrigeration and Air conditioning - Arora & Domkundwar (Dhanpat Rai & Co.(p) Ltd, Delhi).
8. Refrigeration and Air conditioning – Stoecker & Jones (McGraw-Hill Education India Pvt. Ltd - New Delhi).
9. Refrigeration and Air conditioning – R.K. Rajput (Katson publications)

BCE-151 **ENGINEERING GRAPHICS**

Course category	:	Engineering Fundamentals (EF)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 0, Tutorial: 0, Practical: 4
Number of Credits	:	2
Course Assessment Methods		Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory.
Course Objective	:	This course aims at the following educational objectives: Comprehend general projection theory, with emphasis on orthographic projection to represent three-dimensional objects in two-dimensional views (principal, auxiliary, sections). Dimension and annotate two-dimensional engineering drawings.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. How Engineering Drawing helps to sketch the imagination?
2. Able to effectively practice the different scales for drawings.
3. Effectively analyze the geometrical shapes and to be able to draw.
4. Know about out solids and discuss about their classification.
5. How to implement the different views for a solid placed in 3dspace.
6. Construction of the object from different perspective.

Topics Covered

UNIT-I

Conic Sections and Orthographic Projections Introduction

Introduction to Engineering Drawing covering, Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales.

Orthographic Projections

Orthographic Projections covering Principles of Orthographic Projections- Conventions Projections of Pointsand lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Plane

UNIT-II

Projection of Regular Solids

Projections of Regular Solids covering those inclined to both the Planes- Auxiliary Views

UNIT-III

Sections and Sectional Views of Right Angular Solids

Sections and Sectional Views of Right Angular Solids covering, Prism, Cylinder, Pyramid, Cone – AuxiliaryViews; Development of surfaces of Right Regular Solids - Prism, Pyramid, Cylinder and Cone

UNIT-IV

Isometric Projections

Isometric Projections covering, Principles of Isometric projection – Isometric Scale, Isometric Views, Conventions; Isometric Views of lines, Planes, Simple and compound Solids; Conversion of Isometric Views to Orthographic Views and Vice-versa, Conventions. Overview of computer graphics, demonstrating knowledge of the theory of CAD software.

Text & Reference books:

1. Engineering Drawing-Bhat, N.D.& M. Panchal, Charotar Publishing House, 2008
2. Engineering Drawing and Computer Graphics- Shah, M.B. & B.C. Rana, Pearson Education, 2008
3. A Textbook of Engineering Drawing-Dhawan, R.K., S. Chand Publications,2007
4. Textbook on Engineering Drawing-Narayana, K.L. & P Kannaiah, Scitech Publishers, 2008

BME-155 ENGINEERING THERMODYNAMICS

Course category : PLBSE

Pre-requisite Subject : NIL

Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 0

Number of Credits : 4

Course Assessment methods Continuous assessment through tutorials, attendance, home assignments, quizzes and two minor tests and one major theory examination

Course Objectives : This course deals with the fundamentals of Thermodynamics including thermodynamic systems and properties, relationships among the thermos-physical properties, the laws of thermodynamics and applications of these basic laws in

thermodynamic systems. This course will provide the essential tools required to study thermodynamic systems in Mechanical Engineering

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The basic understanding of the nature of the Thermodynamic processes for pure substances and ideal gases and ability to demonstrate the Zeroth law and First Law of Thermodynamics.
2. Ability to apply the First Law of Thermodynamics for control surface and control volume systems and demonstrate the Second Law of Thermodynamics and its application to various systems.
3. Students will demonstrate ability to use the Second Law of Thermodynamics for entropy balance analysis of different Thermodynamics processes of systems and control volume.
4. Ability to demonstrate the various plots pertaining to properties of steam and Thermodynamic cycles and the working of IC Engines.
5. Estimate vapor-liquid properties and solve basic problems using steam tables, Mollier diagrams and equation of state.
6. Apply the first and second laws of thermodynamics for the complete thermal analysis of vapor power cycle.

Topics Covered

UNIT-I 9

Fundamental Concepts and Definitions

Introduction and definition of thermodynamics, Dimensions and units, Microscopic and Macroscopic approaches, Systems, surroundings and universe, Concept of continuum, Controlsystem boundary, control volume and control surface, Properties and state, Thermodynamicproperties, Thermodynamic path, process and cycle, Thermodynamic equilibrium, Reversibilityand irreversibility, Quasi static process, Energy and its forms, Work and heat, Gas laws, Ideal gas,Real gas, Law of corresponding states, Dalton‘s law, Amagat‘s law, Property of mixture of gases.

Zeroth law of thermodynamics

Zeroth law of thermodynamics, Temperature and its ‘measurement, Temperature scales

First law of thermodynamics I

Thermodynamic definition of work, Thermodynamic processes, Calculation of work in various processes and sign convention, Non-flow work and flow work, Joules‘ experiment, First law of thermodynamics, Internal energy and enthalpy

UNIT-II 9

First law of thermodynamics-II

First law of thermodynamics applied to open systems, Steady flow systems and their analysis, Steady flow energy equation, Boilers, Condensers, Turbine, Throttling process, Pumps etc. First law analysis for closed system (non flow processes), Analysis of unsteady processes such as filling and evacuation of vessels with and without heat

transfer, Limitations of first law of thermodynamics, PMM-I

Second law of Thermodynamics

Devices converting heat to work, Thermal reservoir, Heat engines, Efficiency, Devices converting work to heat, Heat pump, refrigerator, Coefficient of Performance, Reversed heat engine, Kelvin Planck statement of second law of thermodynamics, Clausius statement of second law of thermodynamics, Equivalence of two statements of second law of thermodynamics, Reversible and irreversible processes, Carnot cycle and Carnot engine, Carnot theorem and it‘s corollaries,
thermodynamic temperature scale, PMM-II

UNIT-III 9

Entropy

Clausius inequality, Concept of Entropy, Entropy changes in different thermodynamic processes, Tds equation, Principle of entropy increase, T-S diagram, Statement of the third law ofthermodynamics.

Availability and Irreversibility

Available and unavailable energy, Availability and Irreversibility, Second law efficiency,Helmholtz & Gibb‘s function

UNIT-IV 9

Properties of steam and thermodynamics cycles

Pure substance, Property of steam, Triple point, Critical point, Sub-cooled liquid, Saturation states, Superheated states, Phase transformation process of water, Graphical representation of pressure, volume and temperature, P-T & P-V diagrams, T-S and H-S diagrams, use of property diagram, Steam-Tables & Mollier charts, Dryness factor and it‘s measurement, processes involving steam in closed and open systems, Simple Rankine cycle

Introduction to working of IC engines

Compression Ignition engines, Spark Ignition engines, 2 stroke and 4 stroke engines, Performance parameters of IC engine, Heat balance sheet

Text & Reference books:

1. Engineering Thermodynamics - P.K. Nag (Tata McGraw Hill)
2. Fundamentals of Thermodynamics – Sonntag (Wiley India Pvt. Ltd)
3. Fundamentals of Classical Thermodynamics - Van Wylen (John Wiley & sons)
4. Thermodynamics - J.P. Holman (McGraw Hill)
5. Engineering Thermodynamics - Jones and Dugans (PHI Learning Pvt. Ltd)

BSM-203		**Operations Research (ME)**
Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination

Course Objectives The course is aimed to develop the mathematical skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Identify and develop operational research models from the verbal description of the real system.
2. Be able to build and solve Transportation Models and Assignment Models.
3. Knowledge of formulating mathematical models for quantitative analysis of managerial problems in industry
4. Aware with the basic concepts and tools of game theory and can apply these tools to real-life situations.
5. Understand different queuing situations and find the optimal solutions using models for different situations.
6. Be able to design new simple models, like: CPM, PERT to improve decision making.

Topics Covered

UNIT-I 9

Linear Programming: Definitions, characteristics, necessity, scope and objectives of O.R. Phases of operations Research study, Limitations of O.R., Linear Programming, assumptions in L.P. formulation of mathematical models for various types of L.P. problems, graphical methods of solving L.P. problems, Limitations of L.P. methods. Simplex method, artificial variable technique-the big-M method, two phase Simplex method, degeneracy, unconstrained variables, duality in L.P.

UNIT-II 9

Transportation and Assignment Problems: Transportation model formulation, and solution of transportation problems (Optimal), Assignment model, formulation and solution of assignment problems, sequencing problems.

UNIT-III 9

Game Theory and Network Techniques: Game theory, solution of games with and without saddle point, rules of dominance, arithmetic, and algebraic methods for 2x2 games, solution of 2xn or m x 2 games. PERT & CPM Models: Characteristics & uses, drawing of network, removal of redundancy in network, computing EST, LFT, critical path, project completion time, Free Slack, Total slack, and independent slack, Project crashing.

UNIT-IV 9

Queuing Theory: Elements of Queuing model, Pure-birth and Pure-death models, Empirical queuing models – M/M/1: ∞/FCFS, M/M/1: N/FCFS and M/M/C: ∞/FCFS models and their steady state performance analysis.

Text & References Books

1. Hillier, F. S., & Lieberman, G. J. Introduction to operations research- concepts and cases. New Delhi: Tata McGraw Hill (Indian print).
2. Taha, H. A. Operations research-an introduction. New Delhi: Pearson Prentice Hall.
3. Ravindran, A., Phillips, D. T., and Solberg, J. J. Operations research- principles and practice. New Delhi: Wiley India (P.) Ltd. (Indian print).
4. Kanti Swaroop, P K Gupta and Manmohan, Operations Research, Sultan Chand & Sons
5. Gross, D., Shortle, J. F., Thompson, J. M., & Harris, C. M. Fundamentals of queueing theory. Wiley India (P.) Ltd. (Indian print).

BME 201 **MANUFACTURING PROCESSES**

Course category : Engineering Fundamentals (EF)
Pre-requisite Subject : NIL

Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and two Minor test and One Major Theory Examination
Course Objectives:		The main objective of this course is to emphasize the importance manufacturing sciences in the day-to-day life, and to study the basic manufacturing processes and tools used. The course is delineated particularly to understand the conventional manufacturing processes like casting, metal forming, and welding process.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The students will be able to understand the basic manufacturing processes and different types of mechanical properties of metals.
2. Able to understand to basic concept of different forming processes.
3. The basic knowledge of different casting processes and foundry tools used for the manufacturing of different products.
4. The knowledge of different machine tools and machining processes, welding processes and their applications.
5. The knowledge of sheet metal processes and their applications.
6. The basic knowledge of different welding processes, power metallurgy and their applications.

Topics Covered

UNIT-I

Introduction 9

Introduction and importance of Manufacturing processes, classification, and overview of Manufacturing processes.

Mechanical Properties of Materials

Strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, malleability, toughness hardness, resilience, hardness, machine ability, formability, weldability, Elementary ideas of fracture fatigue & creep.

Forming Processes

Hot-working & cold-working, Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube drawing and Extrusion, and their uses. Press-work: Die & Punch assembly, cutting and forming, its applications.

UNIT-II

Casting 9

Pattern making, Materials, pattern making tools, pattern types and allowances. Type and composition of Molding sands and their desirable properties. Foundry tools, Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Brief description of various types of casting processes.

UNIT-III

Welding 9

Introduction, classification of welding processes. Gas-welding, types of flames and their applications. Electric-Arc welding. Resistance welding. Soldering & Brazing processes and their uses.

Powder Metallurgy

Introduction of powder metallurgy process: powder production, blending, compaction, Sintering

UNIT-IV

Machining 9

Introduction, Lathe-machine: principle, types, main parts, specifications and operations performed on it., Basicdescription of machines and operations of Shaper-Planer, Drilling, Milling & Grinding.

Jigs & Fixtures

Locating & Clamping devices & principles. Jigs and fixtures and its applications.

Sheet Metal Work

Tools and equipment used in sheet metal work, metals used for sheets, standard specification for sheets, Types of sheet metal operations: shearing, drawing, bending

Text & Reference books:

1. Workshop Technology Vol-I-B. S. Raghubanshi (Dhanpat Rai and Sons)
2. Workshop Technology Vol-II-B. S. Raghubanshi (Dhanpat Rai and Sons)
3. Production Technology - R.K. Jain (Khanna publication
4. Manufacturing Processes- H. N. Gupta, R. C. Gupta, Arun Mittal (New Age publisher)
5. Manufacturing Science -Ghosh and Mallik (EWP)
6. Manufacturing processes – Santosh Bhatnagar (B S publication)
7. Production Technology – P. C. Sharma (S. Chand)
8. Manufacturing Technology – Machine Tools- P. N. Rao (TMH)
9. Manufacturing Technology – Foundry, Forming and Welding- P. N. Rao (TMH).
10. Manufacturing Engineering & Technology- Kalpakjian (Pearson)

BHM-112/162 **INDUSTRIAL SOCIOLOGY**

Course Category:	Humanities & Social Science Elective (HSSE)
Pre-requisite Subject:	None
Contact hours/week:	2 hours per week
No of Credits:	Lecture: 2, Tutorial:0, Practical: 0 (Total Credit: 02)
Course Assessment Methods:	Continuous assessment through attendance, home assignments, quizzes and two minor test, one major theory.

Course Objective: The Course aims:

To understand the theoretical frameworks of psychology that can be applied to make an organization more effective and efficient as well as acquire the necessary interpersonal, behavioural, and technical skills for application in the work setting.

Course Outcomes: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course.

1. Student will be able to understand the various facets of sociology and its problems
2. Student will be able to identify, formulate and solve the real-life problems with positive attitude.
3. It inculcates the habit of learning and developing the industrial problems from sociological perspectives.
4. Student will be able to enable to understand and appreciate the application of Sociology in Industrial environment.
5. Provide basic understanding of the social structures and the developmental stages of the process of socialization.

6. To understand the major social influence on industry and it's working.

UNIT-I **6**

Introduction to Industrial Sociology Nature, Scope and importance of Industrial Sociology, Development of Industrial Sociology and other social sciences. Understanding social structure and social processes: Perspectives of Marx, Weber & Durkheim

UNIT-II **6**

Rise and development of industry Early industrialisation- Types of productive systems- Evolution of Productive system and Development of Industry, Primitive Stage, Agrarian economy Stage, Handicrafts Stage, Guild System, Feudal or Manorial System, Putting out System, Industrial Revolution, Industrialisation Causes and Consequences.

UNIT-III **6**

Contemporary issues in Industrial Sociology Industrial Policy Resolutions Social change in contemporary India: Modernization and globalization, Secularism and communalism, Nature of development, Processes of social exclusion and inclusion, Changing nature of work and organization, Industrial Grievances, Industrial conflicts, Industrial disputes in India, Strike and Lock-out, Promote industrial Peace. Industrial Policy Resolutions.

UNIT-IV **6**

Industrial relations machinery in India Tripartite and Bipartite Machinery, Code of discipline and standing orders and Trade unionism, The National Commission on Labour, Industrial Relations and Technology, Sociological Approach to Industrial relations. Invisible Glass Ceiling and Need for Gender Parity. Gender based sensitization for ideal professional environment.

Text and References books:

1. Chandoke, Neera & Praveen Priyadarshi (2009), *Contemporary India: Economy, Society and Politics*, Pearson.
2. Despandey, Archana., (2010). *Industrial Sociology*, Sun India Publications, New Delhi.
3. Dhanagare, D.N., (1998) *Themes and Perspectives in Indian Sociology*, Rawat.
4. Durae, Pravin., (2013) *Education in South Asia*, Dorling Kindersley (India) P. Ltd. Pearson.
5. Gahlawat, Dalvir S. & Singh, Sudhir N., (2015) *Feminine Consciousness: Glimpsing Indian Perspectives*, Authorspress, New Delhi.
6. Ramaswamy, E.A. & Ramaswamy, U. (1981), *Industry and Labour*, OU P.
7. Singh, Sudhir N. & Gahlawat, Dalvir S. (2013) *Post Feminism in India: Myth or Reality*, Adhyayan Publishers & Distributers, New Delhi.
8. Singh, Sudhir N. & Gahlawat, Dalvir S. (2012) Indian Social Discourse: Relocating, class, caste, gender and other emerging, margins, *International Journal of Research in Social Sciences*, Volume -2, Issue-4.

BME-202 **FLUID MECHANICS**

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial:1, Practical: 2
Number of Credits	:	5

Course Assessment methods:	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce, Two Minor tests and One Major Theory & Practical. Examination.
Course Objectives	:	The course on fluid mechanics is devised to introduce fundamental aspects of fluid flow behaviour. Students will learn to develop steady state mechanical energy balance equation for fluid flow systems, estimate pressure drop in fluid flow systems and determine performance characteristics of fluid machinery.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. The students should be able to understand the fundamental concepts of fluid mechanics and knowledge of fluid and its properties, types of fluid flows.
2. The students should be able to understand different parameters of fluid statics, pressure transducers and pressures on plane and curved surface. and curved surfaces, stability of immersed and floating bodies.
3. The students should be able to understand the various aspects of Laminar, Turbulent Flow and other types of flow over different types of bodies.
4. The students should be able to carry out dimensional analysis and control volume analysis in fluid mechanics.
5. The students should be able to design and solve the fluid problems of various types.
6. The students should be able to formulate the new designs of fluid flow problems, which should be helpful to society.

Topics Covered

UNIT-I

Introduction 9

Fluid and continuum, Physical properties of fluids, Rheology of fluids

Fluid Statics

Pressure-density-height relationship, Pascal law, manometers and its types with applications, pressure transducers and pressure gauges, pressure on horizontal, Vertical and inclined plane surfaces. Pressure on curved surfaces, centre of pressure, buoyancy, stability of immersed and floating bodies.

UNIT-II

Kinematics of Fluid flow 9

Types of fluid flows: Steady and unsteady flows, uniform and non-uniform flows, laminar and turbulent flows, rotational and irrotational flows, compressible and incompressible flows, subsonic, sonic and supersonic flows, sub-critical, critical and supercritical flows-, one-, two- and three-dimensional flows, streamlines, continuity equation, circulation, stream function and velocity potential function.

Dynamics of Fluid Flow

Euler‘s Equation of motion along a streamline and its integration, Bernoulli‘s equation and its

applications-Pitot tube, orifice meter, venturi meter and bend meter, notches and weirs, momentum equation and its application to pipe bends.

UNIT-III

Laminar and Turbulent Flow 9

Equation of motion for laminar flow through pipes, Velocity distribution and pressure drop in laminar flow through a circular pipe. Stokes ‘law, transition from laminar to turbulent flow, turbulent flow, types of turbulent flow, isotropic homogenous turbulence, scale and

intensity of turbulence, measurement of turbulence, eddy viscosity, mixing length concept and velocity distribution in turbulent flow over smooth and rough surfaces, resistance to flow, major and minor losses, pipe in series and parallel, power transmission through a pipe, siphon, water hammer.

UNIT-IV

Dimensional Analysis and Hydraulic Similitude 9

Dimensional analysis, Buckingham's Pi theorem, important dimensionless numbers and their significance, geometric, kinematics and dynamic similarity, model studies

Boundary Layer Analysis

Boundary layer thickness, boundary layer over a flat plate, laminar boundary layer, application of momentum equation, turbulent boundary layer, laminar sub layer, separation, and its control, Drag and lift, drag on a sphere, a two-dimensional cylinder, and an aerofoil, Magnus effect.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. To verify the momentum equation using the experimental set-up on impact of jet.
2. To determine the coefficient of discharge of an orifice of a given shape. Also to determine the coefficient of velocity and the coefficient of contraction of the orifice.
3. To calibrate an orifice meter and study the variation of the co-efficient of discharge with the Reynolds number.
4. To calibrate a Venturimeter and study the variation of the co-efficient of discharge with the Reynolds number.
5. To calibrate a bend meter and study the variation of the co-efficient of discharge with the Reynolds number.
6. To study the transition from laminar to turbulent flow and to determine the lower critical Reynolds number.
7. To study the velocity distribution in a pipe and to compute the discharge by integrating the velocity profile.
8. To study the variation of friction factor, f for turbulent flow in commercial pipes.
9. To study the boundary layer velocity profile over a flat plate and to determine the boundary layer thickness.
10. To determine Meta-centric height of a given ship model.
11. To determine the head loss for a sudden enlargement
12. To determine the head loss for a sudden Contraction

Text & Reference books:

1. Introduction of Fluid mechanics & Fluid Machines - Som, S.K. & Biswas G. (TMH Pub)
2. Fluid Mechanics &Hydraulic Machines by -R K Bansal (Laxmi publications))
3. Fluid Mechanics & Machinery - S.K. Agarwal (TMH Pub.)
4. Fluid Mechanics through Problems - Garde, R.J. (New Age International Pvt. Ltd, 2e)
5. Fluid Mechanics and hydraulic machines by R K Rajput (Kataria publications)
6. Hydraulics and Fluid Mechanics by Modi and Seth (Rajsons Publications PVT. LTD)

BME-203		**KINEMATICS OF MACHINES**
Course category	:	Program Core (PC)
Pre-requisites	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	To develop skills for designing and analysing linkages, cams, gears and other mechanisms and to provide a foundation for the study of machine design
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the kinematics of links, its classification and applications in different planar mechanisms and machines with different types of kinematic inversions.
2. Ability to determine graphically velocity and accelerations of linkages in different planar mechanisms.
3. The knowledge of exact straight line motion mechanisms and approximate straight line motion mechanisms and working of Universal joint.
4. To be able to synthesize graphically and analytically slider crank mechanism and four bar mechanisms and understand the type of kinematic synthesis of mechanisms.
5. To understand the gear tooth profiles, law of gearing, interference phenomenon, and different types of gear trains for the power transmission.
6. To understand different types of cams and followers' motions, cam profile generation techniques and analytical methods of cam design.

Topics Covered

UNIT-I 9

Introduction

Links-types, Kinematics pairs-classification, Constraints-types, Degrees of freedom of planar mechanisms, Problems, Mobility of four bar linkage-Grashof's law, Grubler's equation, linkage mechanisms, kinematic inversions of four bar chain, slider crank chain and double slider crank chain, limit position, mechanical advantage, transmission angle.

Velocity in Mechanisms:

Relative velocity method, Velocities in four bar mechanism, slider crank mechanism and quick return motion mechanism, Instantaneous center method, Types & location of instantaneous centers, Kennedy's theorem, Velocities in four bar mechanism & slider crank mechanism, Acceleration in Mechanisms

Acceleration of a point on a link, Acceleration diagram for four bar mechanism and slider crank mechanism, Coriolis component of acceleration, Problems

UNIT-II 9

Mechanisms with Lower Pairs

Pantograph, Exact straight line motion mechanisms-Peaucellier's, Hart and Scott Russell mechanisms, Approximate straight line motion mechanisms–Grass-Hopper, Watt and Tchebicheff mechanisms, Universal joint-ratio of shaft velocities

Kinematic Synthesis of Planar Linkages

Relative pole, Relative pole for four bar linkage and slider crank linkage, Graphical Methods-Two and Three position synthesis of four bars and slider crank mechanisms, Analytical method-Freudenstein's equation, Slider crank mechanism, Synthesis of mechanisms, Classification of synthesis problem, Precision points for function generation, Problems

UNIT-III 9

Gears

Classification & terminology, helical, bevel, rack and pinion gears, Law of gearing, Involute and cycloidal tooth profile, Tooth forms & comparisons, Systems of gear teeth, Involute Gears-path of contact, contact ratio, Interference & under cutting in involute gear teeth, Minimum number of teeth on gear and pinion to avoid interference, Problems

Gear Trains

Simple, Compound, Reverted and Epicyclic gear trains, Sun and planet gear, Problems

UNIT-IV 9

Cams

Cams and Followers-Classification & terminology, Follower Motion-Uniform velocity, Simple harmonic motion, Uniform acceleration and retardation, cycloidal motion, Cam Profile generation- Radial cam, Knife edge, roller and flat face followers, Offset roller follower, Oscillating followers, Analytical methods of cam design – tangent cam with reciprocating roller follower and circular arc cam with flat faced follower

Text & Reference Books

1. Theory of Machines-S.S. Rattan (Tata Mc-Graw Hill)
2. Theory of Machines and Mechanisms-Ghosh & Mallik (East West Press)
3. Theory of Machines and Mechanisms- Shigley (Mc-Graw Hill)
4. Theory of Machines and Mechanisms- Rao & Dukkipati (New Age International)
5. Theory of Machines - Thomas Bevan (CBS Publishers)
6. Theory of Machines – Malhotra & Gupta (Satya Prakasan, Tech. India)
7. Kinematics and Dynamics of Machinery-Robert L Norton (Tata McGraw Hill)
8. Mechanism and Machines – Cleghorn W. L. (Oxford University Press)

BME-204 MACHINE DRAWING

Course category	:	Program link basic science and engineering courses (PLBSE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 0, Tutorial:0, Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three Viva, Practical work/record, attendance, and Major Practical Examination
Course Objectives	:	To provide basic understanding and drawing practice of various joint, simple mechanical parts. Selection of Views, additional views for the following machine elements and parts with every drawing proportions.
Course Outcomes	:	This course introduces about different basic components of drawing and their applications in producing the different types of mechanical drawings in the form of projections in first angle and third angle projections for different solid bodies, complex shaped bodies Mechanical members and Assembly drawing.

The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course.

1. Understand layout of drawing sheet, IS codes, scales, different types of lines, section lines, dimensioning, etc.
2. The orthographic projections of simple solids; drawings of parts of temporary fastener, i.e., nuts and bolts and permanent fasteners, i.e., riveted joints and its applications to boiler joint.
3. The knowledge of assembly drawing of cotter joint, knuckle joint, stuffing box, etc. and production drawing of simple machine components.
4. The students should be able to draw the machine drawing of any engineering components. Topics Covered
5. The students should be able to draw and define the different types of materials.
6. The students should be able to understand the significance of Assembly drawings.

Topics Covered

Introduction (1 Drawing Sheet)

Graphics Language, Classification of machine drawings, Layout of drawing sheet, IS codes, Scales, Lines, Section lines, Dimensioning.

Orthographic Projections (2 drawing sheets)

Introduction Principles of first angle and third angle projections, Orthographic views, Drawing of machine elements and three-dimensional objects in first angle projection and third angle projection. Selection of views, Sectional views, and Missing views etc.

Fasteners Drawing (2 drawing sheets)

Temporary fasteners-Screw threads nomenclature, Bolts, and nuts etc.
Permanent fasteners-Rivets and riveting, Types of rivet heads, Types of riveted joints, Boiler joint etc.

Assembly Drawing (2 drawing sheets)

Assembly drawing of cotter joint, knuckle joint, stuffing box, cross head, pedestal bearing, eccentric, lathe tail stock, screw jack, safety valve etc.

Production Drawing (1 drawing sheet)

Types, Use of different symbols such as machining, surface roughness symbols etc, Examples of simple machine elements gear, crank, jig, connecting rod, pulley, piston etc

Free hand sketching (1 drawing sheet)

Introduction, Need for free hand sketching,

EXPERIMENTS

Draw free hand sketching of the following machine components on sketch book

1. Conventional representations of engineering materials
2. Locking arrangements of nuts
3. Types of foundation bolts
4. Types of studs
5. Types of pulleys
6. Types of keys
7. Rigid coupling or Flexible coupling
8. Types of Welded symbols
9. Surface Roughness nomenclature, machining symbols, indication of surface roughness

Text & Reference books:

1. Machine Drawing - KL Narayana, P Kannaiah, KV Reddy (New Age)
2. Machine Drawing - PS Gill (SK Kataria& Sons)
3. Machine Drawing -N. Siddeshswar, P Kannaiah, VVS Shastry (Tata McGraw Hill)

4. Engineering Drawing - RK Dhawan (S. Chand)
5. Engineering Graphics - BK Goel & PK Goel (SK Kataria)
6. Engineering Drawing - Dhananjay A Jolhe (Tata McGraw Hill)
7. Engineering Drawing - CM Agrawal (Tata McGraw Hill).

BSM-252 **Numerical Methods**

Course category	:	Basic Sciences & Maths (BSM)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor Tests and One Major Theory & Practical Examination.
Course Objectives		The objective of this course is to introduce a broad range of numerical methods for solving mathematical problems that arise in science and engineering.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Demonstrate understanding of common numerical methods and how they are used to obtain approximate solutions to otherwise intractable mathematical problems.
2. To find the root of a function using Bisection, Regula falsi, Newton's Method, Aitken's method.
3. To interpolate a curve using Gauss, Newton's interpolation formula.
4. To solve the first order boundary value problem.
5. To develop an understanding of the fundamentals in finding the numerical solutions of the system of equations and to find the eigen value of the matrix.
6. Demonstrate the concepts of numerical methods used for different applications.

Topics Covered

UNIT-I 9

Roots of equation: Bisection method, Regula Falsi Method, Secant Method, Fixed point Iteration Method, Newton Raphson Method, Modified Newton Raphson Method for Multiple roots, derivation of rate of convergence, Aitken Method.

UNIT-II 9

Solutions of system of Linear equations and Eigen Value problem: Linear equations: Direct method for solving systems of linear equations (Gauss elimination, Gauss Jordan, LU Decomposition, Cholesky Decomposition), Iterative methods (Jacobi, Gauss Seidel, Relaxation method). Algebraic Eigen value problem: Power method, Jacobi's method, Given's method.

UNIT-III 9

Interpolations, and Numerical Integration: Relationship in various difference operators, Newton`s Forward and Backward Interpolation, Lagrange and Newton divided difference interpolation, Newton`s Cotes Formula, Trapezoidal Rule, Simpson's 1/3 and 3/8 rule, Gauss Quadrature Formula, Chebyshev's Formula, Piecewise Linear Interpolation, Cubic Spline Interpolation.

UNIT-IV 9

Numerical solution of Ordinary differential equations, and Difference Equation: Single Step Methods: Taylor, Picard, Euler, Modified Euler, and Runge-Kutta Fourth Order Methods. Multistep methods: Milne's and Adam's predictor and corrector methods. Difference equations and their solutions, Rules for finding the particular integral.

EXPERIMENTS

1. To implement Regula-Falsi method to find root of algebraic equation.
2. To implement Newton-Raphson method to find root of algebraic equation.
3. To implement Newton's Divided Difference formula to find value of a function at a point.
4. To implement Numerical Integration by using Simpson's one-third rule.
5. To implement numerical solution of differential equation by Picard's method.
6. To implement numerical solution of differential equation by using Euler's method.
7. To implement numerical solution of differential equation by using Runge – Kutta Method.

Text & Reference books:

1. M.K. Jain, S.R.K. Iyenger and R.K. Jain, Numerical Methods: New Age Publishers.
2. P. Kandasamy, K.Thilagavathi, K.Gunavathi , Numerical Methods., S. Chand & Company.
3. B.S. Grewal; Higher Engineering Mathematics, Khanna Publishers, Delhi.
4. B.V. Ramana; Higher Engineering Mathematics, Tata Mc. Graw Hill Education Pvt. Ltd., New Delhi.
5. Brian Bradie, A Friendly Introduction to Numerical Analysis, Pearson Education, Asia, New Delhi

BME-2521 MECHANICS OF SOLIDS

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	To learn the fundamental concepts of stress, strain, and deformation of solids with applications to bars, beams, and columns.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to determine stresses in solid members under different conditions.
2. Apply knowledge of various kinds of beams for engineering applications.
3. The ability to determine stresses in thin and thick, cylindrical, and thin spherical shells, and buckling loads in long columns under different support conditions.
4. Ability to identify, formulate, and solve engineering & real-life problems.
5. Ability to design a component to meet desired needs within realistic constraints of safety.
6. Able to understand advanced topics of Mechanics of solids for further Research and Industry Applications

Topics Covered

UNIT-I 9

Stress and strain, elastic constants, Poisson's ratio; Principal planes and principal stresses, Mohr's circle for plane stress and plane strain; Bending and torsion and its combination, Strain energy due to principal stresses, Energy of distortion and dilatation. thermal stresses; strain gauges and rosettes.

UNIT-II 9

Beams: Review of SFD BMD, Pure bending, combined direct and bending stresses, shear stresses in beams, combined bending and torsion of solid and hollow circular shafts, Deflection of beams, Equation of elastic curve, Mecaulay's method, Area moment method, Fixed beam carrying point load and uniformly distributed load, continuous beams, Castgliano's theorem

Introduction to Springs, Helical springs under axial loads and axial twist, Deflection of spring by energy method, Open and closed coil helical springs under axial and twist loadings.

UNIT-III 9

Thin cylindrical and spherical shells: Hoop and Longitudinal stresses and strain, cylindrical shell with hemispherical ends, Volumetric strain, Wire wound cylinders, spherical shell.

Thick cylindrical shell: Stresses in thick cylinders subjected to internal or external pressures, Compound cylinders, Stresses due to interference fits.

Columns and Struts: Classification, Euler's theory for long column for different end conditions, Limitations, Rankine formulae for struts/columns. Introduction to other theories.

UNIT-IV 9

Generalised Hooks Law. Introduction to 3D stresses and Mohr's circle. Elastic stabilities and Theories of Failure. Determination of shear centre for I-section and channel section. Requirements, Cooling & heating systems

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Tension test
2. Deflection test on Cantilever beam
3. Deflection test on simply supported beam
4. Torsion test
5. Spring test
6. Izod Impact test
7. Tensile test using UTM
8. Charpy impact test on a metal specimen
9. Flexural strength of a beam
10. Compressive Test on Cube
11. Brinell hardness test
12. Rockwell hardness test

Text & Reference books:

1. Introduction of Mechanics of Materials – I.H. Shames
2. Strength of Materials-S. Ramamurtham (Dhanpat Rai Publishing Co.)
3. Strength of Materials-R. K. Rajput (S. Chand)
4. Strength of Materials-Ryder (Mcmillan Publishers India Limited)
5. Strength of Materials-Timoshenko and Young (Tata McGraw Hill)
6. Advanced Mechanics of Solids-L S Srinath (Tata McGraw Hill)
7. Mechanics of Solids – Egor P. Popov (Pearson)
8. Mechanics of materials-Pytel (CL Engineering)

BME-252 **ENERGY CONVERSION SYSTEMS**

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	To understand the fundamental principles of thermodynamics energy transfer in a variety of engineering systems and to comprehend the application of the laws of thermo-fluid mechanics to energy conversion systems.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the general principles of mass and energy conservation and the thermodynamic relations.
2. Ability to perform the analysis of combustion of fuels and related calculations.
3. Attain the knowledge of different types of boilers and condensers, their mountings and accessories and different power cycles.
4. Ability to perform the first law and second law analyses of vapor power cycles.
5. Understand the knowledge of steam & gas nozzles and different types of steam turbines with related parameter calculations.
6. Understand the principle and working of gas turbine engines and related calculations and the principle and working of aircraft propulsion.

Topics Covered

UNIT-I 9

Thermodynamic relations

Conditions for exact differentials, Maxwell relations, Clapeyron equation, Joule-Thompson experiment, Coefficient of volume expansion, Adiabatic and Isothermal compressibility.

Fuels and Combustion

Combustion analysis, heating values, air requirement, Air/Fuel ratio, heat of reaction, heat of formation, Adiabatic flame temperature.

UNIT-II 9

Boilers and condensers

Classifications and working of boilers, boiler mountings and accessories, air pre-heater, feed water heater, super heater, Boiler efficiency, Boiler trial and heat balance, Draught and its calculations, Classifications of condensers, condenser efficiency.

Vapor Power cycles

Carnot vapor power cycle, Rankine cycle, reheat cycle, Regenerative cycle, low temperature power cycles, Binary vapor cycle, Cogeneration & Combined cycles, Exergy analysis.

UNIT-III 9

Steam and Gas Nozzles

Flow through Convergent and convergent-divergent nozzles, variation of velocity, Choked flow, throat area, Nozzle analysis and efficiency, Off design operation of nozzle, Effect of friction on nozzle, Super saturated flow.

Steam Turbines

Classification of steam turbine, Impulse and Reaction turbines, Stage and Overall efficiency, Reheat factor, Bleeding, Velocity diagrams, work transfer and blade efficiency of impulse & reaction turbines and related calculations, Losses in steam turbines, Governing of turbines.

UNIT-IV 9

Gas Turbine Engines

Gas turbine classification, Principles of gas turbine, Brayton cycle, Gas turbine cycles with intercooling, reheat and regeneration and their combinations, Combined cycles.

Jet Propulsion

Introduction to the principles of jet propulsion, Turbojet and turboprop engines and their processes, Principle of rocket propulsion, Introduction to Rocket Engine.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Study of Fire Tube boiler.
2. Study of Water Tube boiler.
3. Study and working of Two stroke petrol Engine.
4. Study and working of Four stroke petrol Engine.
5. Prepare the heat balance sheet for Petrol Engine test rig.
6. Study and working of two stroke Diesel Engine.
7. Study and working of four stroke Diesel Engine.
8. Prepare the heat balance sheet for Diesel Engine test rig.
9. Study of Velocity compounded steam turbine.
10. Study of Pressure compounded steam turbine.
11. Study of Impulse & Reaction turbine.
12. Study of Gas Turbine Model.
13. Determination of Indicated H.P. of I.C. Engine by Morse Test.
14. Any other suitable experiment on thermodynamics.

Text & Reference books:

1. Basic and Applied Thermodynamics - P.K. Nag (TMH)
2. Applied Thermodynamics for Engineering Technologists- Eastop (Pearson Education)
3. Applied thermodynamics - Onkar Singh (New Age International)
4. Thermodynamics: An Engineering Approach – Cengel and Boles (TMH)
5. Thermodynamics and Energy Systems Analysis - Borel and Favrat (CRC Press)
6. Gas turbine Theory & Practice - Cohen & Rogers (Pearson Education)
7. Mechanics and Thermodynamics of Propulsion - Hill and Peterson (Pearson Education)

BME-253 **DYNAMICS OF MACHINE**

Course category : Program Core (PC)
Pre-requisite Subject : ----
Contact hours/week : Lecture: 3, Tutorial: 0, Practical: 2

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	To equip the student with fundamental knowledge of dynamics of machines so that student can appreciate problems of dynamic force balance, transmissibility of forces, isolation of systems, vibrations.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Analyze the mechanisms for static and dynamic equilibrium.
2. Carry out the balancing of rotating and reciprocating masses
3. Analyze different types of governors used in real life situation.
4. Analyze the gyroscopic effects on disks, airplanes, stability of ships, two and four wheelers
5. Understand the free and forced vibration phenomenon.
6. Determine the natural frequency, force and motion transmitted in vibrating systems.

Topics Covered

UNIT-I

Static & Dynamic Force Analysis 9

Static equilibrium of two/three force members, Static equilibrium of member with two forces and torque, Static force analysis of mechanism, D'Alembert's principle, Equivalent offset inertia force, Dynamic force analysis of four link mechanism and slider crank mechanism, Dynamically equivalent system

Turning Moment & Flywheel

Engine force analysis-Piston and crank effort, turning moment on crankshaft, turning moment diagrams-single cylinder double acting steam engine, four stroke IC engine and multi-cylinder steam engine, Fluctuation of energy, Flywheel, and its design

UNIT-II

Governors 9

Terminology, Centrifugal governors-Watt governor, Dead weight governors-Porter & Proell governor, Spring controlled governor-Hartnell governor, Sensitivity, Stability, Hunting, Isochronism, Effort and Power of governor

Gyroscopic Motion

Principles, Gyroscopic torque, Effect of gyroscopic couple on the stability of aero planes & automobiles

UNIT-III

Balancing of Machines 9

Static and dynamic balancing, balancing of several masses rotating in the same plane and different planes, balancing of primary and secondary forces in reciprocating engine, Partial balancing of two-cylinder locomotives, Variation of tractive force, swaying couple, hammer blow, Balancing of two cylinder in-line engines

Mechanical Vibrations

Types of vibrations, Elements of vibrating system, Classification, Degrees of freedom, Single degree free & damped vibrations of spring-mass system, Logarithmic decrement, Torsional vibration, Forced vibration of single degree system under harmonic excitation, Critical speeds of shaft

UNIT-IV

Friction 9

Laws of friction, Efficiency on inclined plane, Screw friction, Screw jack, Efficiency, Friction in journal bearing-friction circle, Pivots and collar friction-Flat and conical pivot bearing, Flat collar bearing

Clutches, Bakes & Dynamometers

Single and multiple disc friction clutches, Cone clutch, Brakes-types, Single and double shoe brake, Simple and differential Band brake, Band and Block brake, Absorption and transmission, dynamometers, Prony brake and rope brake dynamometers

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Experiments on simple and dead weight governor
2. Experiment on spring-controlled governor
3. Experiment on gyroscope
4. Experiment on critical speed of shaft
5. Experiment on longitudinal vibration
6. Experiment on transverse vibration
7. Experiment on static/dynamic balancing
8. Experiment on Gear trains
9. Experiment on Gears tooth profile, interference etc.
10. Study of simple linkage models/mechanisms
11. Study of inversions of four bar linkage
12. Study of inversions of single/double slider crank mechanisms
13. Experiment on Brake
14. Experiment on clutches/dynamometers
15. Experiments on friction

Text & Reference books:

1. Theory of Machines - Thomas Bevan (CBS Publication)
2. Theory of Machines and Mechanisms- Shigley (Oxford University Press-New Delhi)
3. Theory of Machines and Mechanisms-Ghosh & Mallik (East West Press)
4. Theory of Machines and Mechanisms- Rao & Dukkipati (Wiley)
5. Theory of Machines - S.S. Rattan (Tata McGraw Hill)
6. Theory of Machines – R.K. Bansal (Laxmi)
7. Mechanics of Machines – V. Ramamurti (Alpha Science Intl Ltd.)
8. Theory of Machines – Khurmi & Gupta (S Chand)
9. Theory of Machines – P.L. Ballaney (Khanna)
10. Theory of Machines – V. P. Singh (Dhanpat Rai publisher)

BME 254 **MANUFACTURING SCIENCE**

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination

Course Objectives : This course introduces manufacturing processes that are used in industry to manufacture products that are widely used in daily life. Students can compare the existing technologies used in casting, shaping, forming, property enhancing, joining and assembly process.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing thiscourse

1. Able to understand the fundamentals and analysis of Forging and Rolling processes.
2. Knowledge of wire drawing, extrusion, sheet metal working, and unconventional metal forming process.
3. Know about principles, working and applications of various types of welding processes andtheir thermodynamic and metallurgical aspects.
4. Able to understand pattern allowances, molding sand properties, elements of mold and various casting processes.
5. Understand the mechanics of metal cutting, tool geometry, tool life and economics of metal cutting
6. Able to understand the concept of grinding wheel designation and various grinding process.

Topics Covered

UNIT-I

Introduction 9

Importance of manufacturing, economic & technological considerations in manufacturing, classification of manufacturing processes, materials & manufacturing processes for common items

Metal forming processes

Elastic & plastic deformation, Yield 's criteria. Hot & cold working. Analysis of forging process for slab and disc. Work required for forging. Hand, power & drop Forging. Analysis of Rolling Process. Analysis of Wire/strip drawing, Tube drawing, Extrusion and its application. Defects in metal forming processes.

Sheet metal working:

Presses and their classification Die & punch assembly and press work methods and processes. Cutting/Punching mechanism, Blanking & piercing. Compound & progressive dies. Flat-face & Inclined-face punches and load calculation. Analysis of forming process like cup/deep drawing. Bending & spring-back.

Unconventional metal forming processes

Unconventional metal forming or High Energy Rate Forming (HERF) processes — explosive forming, electromagnetic, electro-hydraulic forming.

UNIT-II

Welding: Survey of welding and allied processes. Gas welding and cutting, process and equipment. Arc welding: Power sources and consumables. TIG & MIG processes and their parameters. Resistance welding - spot, seam projection etc. Other welding processes — atomic hydrogen, submerged arc, electroslag, friction. Soldering & Brazing. Thermodynamic and Metallurgical aspects in welding. Shrinkage/residual stress in welds. Defects in welds and their remedies. Weld decay in Heat affected zone (HAZ). 9

UNIT-III

Casting (Foundry) 9

Basic principle & survey of casting processes. Types of patterns and allowances. Types and properties of molding sand, sand testing. Design considerations for elements of mould— Gate, Riser, Runner & Core. Solidification of casting. Sand casting— defects, remedies. Cupola furnace. Other casting processes— Die Casting, Centrifugal casting, Investment casting, Continuous castingand CO_2 casting etc.

UNIT-IV

Metal Cutting 9

Mechanics of metal cutting. Geometry of tool and nomenclature. ASA system. Orthogonal/ Oblique cutting. Mechanics of chip formation, types of chips. Shear angle relationship. Merchant's force circle diagram. Cutting forces & power required. Cutting fluids/lubricants. Tool materials. Tool wear and tool life. Machinability. Dynamometer. Economics of metal cutting

Grinding: Grinding wheels, abrasives (bonds & cutting action). Grinding wheel specification. Wear of grinding wheel— dressing & truing, Surface, and cylindrical grinding. Center less grinding.

EXPERIMENTS

Minimum eight experiments are to be conducted from the following:

1. Design and Pattern making
2. Making a mould (with core) and casting.
3. Study & operation of hand & power forging.
4. Press work experiment such as blanking/piercing, washer, making etc.
5. Wire drawing/extrusion on soft material.
6. Shear-angle determination (using formula) with tube cutting (for orthogonal) on lathe machine
7. Bolt (thread) making on Lathe machine
8. Gear cutting on milling machine
9. Machining a block on shaper machine
10. Study of different types of tools and its materials
11. Experiment on tool wear and tool life
12. Experiments on welding (Gas, Arc & resistance)
13. Experiment on unconventional machining

Text & Reference Books

1. Manufacturing Science -Ghosh and Mallik (EWP)
2. Manufacturing Engineering & Technology- Kalpakjian (Pearson)
3. Materials and Manufacturing - Paul Degarmo. (TMH)
4. Manufacturing Technology – Foundry, Forming and Welding- P. N. Rao (TMH).
5. Manufacturing Technology: Metal Cutting & Machine Tools- P. N. Rao (TMH)
6. Advanced Machining Process - VK Jain (Allied Publisher)
7. Fundamentals of Metal Cutting & Machine Tools – Juneja & Shekhon (New Age International)
8. Manufacturing Processes Vol I – H. S. Shan (Pearson)
9. Fundamental of Modern Manufacturing – M. P. Groover (PHI)
10. Production Engineering Science - P.C. Pandey (Standard publisher)
11. Production Technology - R.K. Jain (Khanna publication)
12. Production Engineering – P. C. Sharma (S. Chand)
13. Workshop Technology Vol1-B. S. Raghubanshi (Dhanpat Rai and Sons)
14. Workshop Technology Vol-II-B. S. Raghubanshi (Dhanpat Rai and Sons)

BME-255 **MEASUREMENT & METROLOGY**

Course category	:	Program link basic science and engineering courses (PLBSE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial: 0, Practical: 2
Number of Credits	:	3

Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	The main objective of this course is to make students familiar with the mechanical measuring systems, and the standard measurement methods. It further aims to make them to understand the basic measurement systems in the real time engineering applications.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understanding of measurement and measuring instruments, sensors and transducers, calibration, and concept of errors in measurement.
2. The knowledge of measurements of pressure, strain, temperature, force, torque, and nanometrology.
3. The knowledge of standards of linear measurement, limit fits and tolerances, interchangeability, and standardization.
4. Able to understand the concept of measurement and inspection.
5. The knowledge of measurement of geometric forms like straightness, flatness, roundness, tool maker‘s microscope, profile project autocollimator, Interferometry, Measurement of screw threads, gears and surface texture.
6. The knowledge of nanometrology, microscopy like: SEM, TEM, AFM and XRD etc.

Topics Covered

UNIT-I 6

Mechanical Measurements

Introduction to measurement and measuring instruments, Generalized measuring system and functional elements, units of measurement, static and dynamic performance characteristics of measurement devices, calibration, concept of error, sources of error

Sensors and Transducers

Types of sensors, types of transducers and their characteristics

UNIT-II 6

Pressure Measurements

Introduction, Pressure Measurement Scales, Methods of Pressure Measurement, Classification of Pressure Measuring Devices, Manometers for Pressure Measurement, Ring Balance, Inverted Bell Manometer, Elastic Transducers, Electrical Pressure Transducers, Resistance-type Transducer, Potentiometer Devices, Inductive-type Transducer, Capacitive-type Transducer, Piezoelectric-type Transducer, Varying Pressure Measurement

Strain measurement

Types of strain gauges and their working, strain gauge circuits, temperature compensation

Measurements of force and torque

Different types of load cells, elastic transducers, pneumatic& hydraulic systems

Temperature measurement

Thermometers, bimetallic thermocouples, thermistors and pyrometers

UNIT-III 6

Standards of linear measurement, line, and end standards. Limit fits and tolerances. Interchangeability and standardisation, Linear and angular measurements devices and systems

Comparators: Sigma, Johansson's Microkrator, Limit gauges classification, Taylor's Principle of Gauge Design.

Measurement and Inspection

Dimensional inspection–Tolerance, Limit gauging, comparators, Surface roughness, Feature inspection

UNIT-IV 6

Measurement of geometric forms like straightness, flatness, roundness, Tool makers microscope, profile projector, autocollimator, Principle and use of interferometry, optical flat, Measurement of screw threads and gears, Surface texture: quantitative evaluation of surface roughness and its measurement.

Nanometrology

Importance of Nanometrology, Introduction to Microscopy, Transmission Electron Microscope, Scanning Electron Microscope, Scanning Tunnelling Microscope, Atomic Force Microscope, X-ray Diffraction System, Principles of XRD, Applications of XRD System

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. To measurement of strain (gauge) through MS flat iron with help of Digital Strain indicator.
2. Measurement of displacement using linear variable differential transducer (LVDT)
3. To determine the temperature of bulb filament with the help of partial radiation pyrometer
4. To demonstrate the application of the law of intermediate Temperature
5. To measure the diameter of 'GO' and "NOT GO" Ends of a plug gauge with the help of micrometre and to determine the tolerance provide.
6. To measure the amount of clearance provided in the given fit with the help of dial calliper
7. To measuring the included angle of given hexagonal/ octagonal piece with the help of venire bevel protractor and to verify the same using the formula.
8. To measure the taper angle of given with the help of slip gauges and sine bar.
9. To measure the effective diameter of a screw thread using three wire method of a 1‖ BSW tap and find the flank angle.
10. To study and sketch of tool mater microscope for measurement of dimensional parameters of the given work piece

Text & Reference Books:

1. Engineering Metrology and Measurements - N.V. Raghavendra & l. Krishnamurthy (OXFORD University Press)
2. Mechanical Measurement - Jain, R.K (Khanna Publishers)
3. Mechanical Measurements and Control - Kumar D.S. (Metropolitan, N. Delhi)
4. Engineering Metrology - Hume K.J. (MacDonald and Co. 1963)
5. Mechanical Measurement – Sirohi (New Age Publishers)
6. Engineering Metrology- Gupta, I.C. (Dhanpat Rai & Sons, New Delhi, 1994)
7. Mechanical Measurements - Beckwith Thomas G. (Narosa Publishing House, N. Delhi)
8. Measurement Systems, Application Design - Doeblein E.O (McGraw Hill, 1990.)

BHM-301 ENGINEERING AND MANAGERIAL ECONOMICS

Course category	:	Management (M)
Pre-requisites	:	---
Contact Hours/Week	:	Lecture: 2, Tutorial: 0, Practical: 0
Number of Credits	:	2
Course Assessment Methods	:	Continuous assessment through attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	(i) Acquire knowledge of economics to facilitate the process of economic decision making (ii) Acquire knowledge on basic financial management aspects and develop the skills to analyze financial statements
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Students will acquire basic knowledge in Engineering & managerial economics, which allows students to gain theoretical and empirical skill of economics.
2. To make Engineering students prepared for economic empowerment so that they could manage their wealth, help them in starting their own business or during managerial period.
3. Students will develop Interdisciplinary skills which can help them to thrive in the life- long changing environment in various fields of Industry of Economics.
4. Students will acquire practical knowledge of economics, the kind of markets, cost theory, various issues of demand and other major economic concepts.
5. Able to explain succinctly the meaning and definition of managerial economics; elucidate on the characteristics and scope of managerial economics.
6. To learn about the management and economics of the industrial environment

Topics Covered

UNIT-I

Introduction to the Managerial Economics- Economics and Managerial economics, Review of Economic Terms and Economic Rationality, Law of diminishing marginal utility, Theories of Profit, Decision making Process with reference to Managerial economics, Managerial Economics, and its application in engineering perspective. 6

UNIT-II

Theory of Demand: Law of Demand, Demand Function, Types of Demand, Demand Schedule, Demand Curve, Shift in Demand Curve, Factors affecting Demand, Elasticity of Demand, Theory of consumer behaviour Demand **Forecasting:** Qualitative and Quantitative Techniques of forecasting. 6

UNIT-III

Theory of Supply: Law of Supply, Supply Function, Supply Schedule, Supply Curve, Factors, affecting Supply. 6

Types of cost: fixed cost, variable cost, average cost, marginal cost, opportunity cost, Economies of scale.

UNIT-IV

Market Structure: Perfect Competition, Imperfect competition – Monopolistic, Oligopoly, Monopoly, Meaning of Inflation, Types of Inflation, Causes of inflation, Deflation, Business cycle. 6

Text and Reference books

1. Mote, Paul and Gupta, Managerial Economics, T M H, New Delhi.

2. H L Ahuja, Managerial Economics, S Chand & Co. New Delhi
3. P.L. Mehta, Managerial Economics, Analysis, Problems and Cases, Sultan Chand Sons, New Delhi.
4. Prof. D.N. Kakkar, Managerial Economics for Engineering, PHI publication, New Delhi
5. Varshney and Maheshwari, Managerial Economics, Sultan Chand and Sons, New Delhi.

BME-301 MACHINE DESIGN-I

Course category : Program Core (PC)
Pre-requisites : ----
Contact Hours/Week : Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits : 4
Course Assessment Methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and One Major Theory
Course Objectives : The subject provides the concepts of statics and strength of materials used to determine the stress, strain and deflection. It will help students to design common machine elements such as shafts, fasteners, springs, bearings, and gears.
Course Outcomes : The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. The understanding of design of mechanical components/systems, associated design parameters and standards, and knowledge of engineering materials and their properties.
2. The ability to design mechanical components under the static loads and dynamic loads based on different criteria.
3. Demonstrate the ability to design of cotter and knuckle joints and its engineering applications.
4. The ability to design temporary and permanent joints such as riveted, bolted, and welded joints as well as
5. The knowledge of design of circular shafts under the combined loadings,
6. Demonstrate the ability to design different types of keys, rigid & flexible couplings.

Topics Covered

UNIT-I

Introduction 9

Definition, Design requirements of machine elements, General design procedure, Introduction to Design for Manufacturing, Interchangeability, Limits, Fits and Tolerances, Standards in design, Selection of preferred sizes

Engineering materials and their properties

Classification, Mechanical properties, Ferrous and non-ferrous metals, Non-metallic materials, Indian Standards designation of carbon & alloy steels, Selection criteria of materials.

UNIT-II

Design under Static Load 9

Modes of failure, Factor of safety and basis of determination, Principal stresses, Torsional and bending stresses, Principal stresses in design of machine element, Theory of failure, Eccentric loading

Design under Variable Loads

Cyclic stresses, Fatigue and endurance limit, Factors affecting endurance limit, Stress concentration factor, Stress concentration factor for machine components, Notch sensitivity, Design for finite and infinite life, Soderberg, Goodman & Gerber criteria

UNIT-III

Design of Joints 9

Types of cotter joints, Design of socket and spigot cotter joint, Gib and cotter joint, Design of knuckle joint, Design of threaded joints, Preload on the bolt, stiffness of bolt and members, efficiency of joints; Design of weld joints, Specification of welds, weld design under different loading conditions, Design of riveted joints.

UNIT-IV

Design of Shafts 9

Cause of failure in shafts, Materials for shaft, Stresses in shafts, Design of shafts subjected to twisting moment, bending moment and combined twisting and bending moments, Shafts subjected to fatigue loads, Design for rigidity

Keys and Couplings

Types of keys, splines, Selection of square & flat keys, Strength of sunk key, Couplings-Design of rigid and flexible couplings

Note: Design data book is allowed in Minor/Major Examinations

Text and Reference books

1. Design of Machine Elements-V.B. Bhandari (Tata McGraw Hill)
2. Mechanical Engineering Design – Joseph E. Shigely (McGraw Hill)
3. Mechanical Design of Machine Components – Norton (Prentice Hall)
4. Fundamentals of Machine Components Design – Juvinall (Wiley)
5. Design of Machine Members - Alex Valance and VI Doughtie (McGraw Hill)
6. Machine design-M.F. Spott (Prentice Hall India)
7. Machine Design-Maleev and Hartman (CBS)

BME-302 HEAT AND MASS TRANSFER

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	The course provides the basics of major heat and mass transfer operations. The objective of this course is to impart knowledge on design of heat and mass transfer equipments. In addition, it also imparts knowledge on optimization of the cost of heat transfer operations used in process industries
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the governing laws of heat transfer and general differential heat conduction equation in different coordinate system.
2. Ability to solve steady state one-dimensional heat conduction problems for plate, cylinder, and sphere.
3. Understand the basic of fins and their application in various equipment's for enhancing the heat transfer and estimation of heat transfer for free convection problems.
4. Understanding of concepts and estimation of heat transfer for forced convection problems.
5. Understanding of condensation and boiling phenomenon on surfaces and able to design the different types of heat exchanger.
6. Understanding the basic concepts, analysis of thermal radiation and its numerical solutions and introduction to mass transfer.

Topics Covered

UNIT-I 9

Introduction to Heat Transfer Modes of heat transfer; Governing law of conduction, convection, and radiation; Effect of temperature on thermal conductivity of materials; Combined modes of heat transfer mechanism.

Conduction General differential heat conduction equation in the cartesian, cylindrical and spherical coordinate systems; Initial and boundary conditions.

Steady state one-dimensional heat conduction in different coordinates with and without energy generation and variable thermal conductivity; Composite Systems; Analogy between heat and electricity flow; Thermal resistance networks; Concept of overall heat transfer coefficients; Critical thickness of insulation.

UNIT-II 9

Fins Different fin geometries; Heat transfer from extended surfaces of uniform cross-sectional area; Fin efficiency and effectiveness; Transient conduction; Lumped system analysis.

Natural Convection Physical mechanism of natural convection; Empirical heat transfer correlations for natural convection over horizontal/vertical plates & cylinders and sphere; Combined free and forced convection.

UNIT-III 9

Forced Convection Basic concepts; Hydrodynamic boundary layer; Thermal boundary layer; Approximate integral boundary layer analysis; Analogy between momentum and heat transfer in turbulent flow over a flat surface; Mixed boundary layer; Flow over a flat plate; Empirical heat transfer relations; Flow inside pipes; Relation between fluid friction and heat transfer.

Boiling and Condensation Classification of boiling; pool boiling; Empirical correlations for boiling heat transfer; Introduction to condensation phenomena; Heat transfer relations for laminar film condensation on vertical plate; Film condensation outside and inside of horizontal tube.

Heat Exchanger Classification of heat exchangers; Overall heat transfer coefficient; Fouling factor; Heat exchanger analysis using LMTD method and Effectiveness-NTU method; Compact heat exchangers.

UNIT-IV 9

Thermal Radiation Basic radiation concepts; Radiation properties of surfaces; Concept of black body; Stefan-Boltzmann law and its quasi-linearization; Planck's law; Wein's displacement law; Kirchhoff's law; Shape factor algebra; Radiation exchange between black and nonblack bodies; Radiation shields; Radiation from gases, vapors and flames; Solar radiation.

Introduction to Mass Transfer Fick's law of diffusion; Steady state equimolar counter diffusion; Steady state diffusion though a stagnant gas film.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Conduction - Determination of thermal conductivity of fluids.
2. Conduction - Composite wall experiment
3. Conduction - Composite cylinder experiment
4. Conduction - Thermal Contact Resistance Effect.
5. Convection - Heat transfer through fin-natural convection.
6. Convection - Heat transfer from vertical cylinder-natural convection.
7. Convection - Heat transfer through fin-forced convection.
8. Convection - Heat Pipe experiment.
9. Boiling - Pool Boiling experiment.
10. Condensation- Film-wise condensation.
11. Condensation- Drop-wise condensation.
12. Heat exchanger - Parallel flow experiment.
13. Heat exchanger - Counter flow experiment.
14. Heat exchanger – Shell and tube experiment.
15. Experiment on Stefan's Law on radiation determination of emissivity.
16. Any experiment on solar collector.

Text & Reference books:

1. Fundamentals of heat transfer – F. P. Incropera & D. P. Dewitt (Wiley)
2. Elements of Heat Transfer - Bayazitouglu & Ozisik (McGraw-Hill)
3. Heat Transfer - J. P. Holman (McGraw-Hill)
4. Principles of Heat Transfer - Frank Kreith & M. S. Von (McGraw-Hill)
5. Heat Transfer – S. P. Sukhatme (Universities Press)
6. Heat Transfer -Y. V. C. Rao (University Press)
7. Heat Transfer - R. Yadav (Central Publishing House)
8. Heat Transfer - Vijay Gupta (New Age International (P) Ltd.)

BME-303 **Additive Manufacturing**

Course Category	:	Program Core (PC)
Pre-requisites	:	----
Contact Hours/Week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through attendance, home assignments, quizzes, two Minor tests and One Major Theory

Course Objectives : To introduce students the basics of additive manufacturing/rapid prototyping and its applications in various fields, reverse engineering techniques. It will familiarize students with different processes in rapid prototyping systems and related software.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Ability to understand the fundamental of Additive manufacturing
2. To comprehend the varieties like liquid based, solid based and powder-based AM technologies, their potential to support design and manufacturing.
3. Ability to understand the three-dimensional printing
4. Ability to demonstrate the applications of AM in design analysis, aerospace, automotive, biomedical and other fields and research challenges associated with AM.
5. Ability to understand the various types of Pre-processing, processing, post-processing errors in AM
6. To acknowledge the various types of data formats and software's used in AM

Topics Covered

UNIT-I

Introduction: Need for Additive Manufacturing, Development of AM systems, AM Process Chain, commonly used Terms, Impact of AM on product development, Virtual prototyping, Rapid tooling, Rapid prototyping to AM, Classification of AM process, Advantages and Limitations, Applications of AM- Material Relationship, Application in Design, Application in Engineering, Analysis and Planning, Aerospace Industry, Automotive Industry, Medical and Bioengineering, Web Based Rapid Prototyping Systems etc. 9

UNIT-II

Liquid-based AM Systems: Stereo lithography Apparatus (SLA): Working principle, Pre-build process, part building and post building processes, photo polymerization SL resin, part quality and process planning, recoating issues, advantages, limitations, and applications. Case studies. 9

Solid ground curing (SGC): Working principle, Process, Applications, Advantages and Disadvantages, Case studies.

Polyjet: working principle, Process, Applications, Advantages and Disadvantages, Case studies.

Solid-based AM Systems: Laminated Object Manufacturing (LOM): Working Principles, details of processes, products, materials, advantages, limitations, and applications - Case studies.

Fused Deposition Modeling (FDM): Principle, details of processes, process variables, types, products, materials, and applications. Case studies. Multi-Jet Modelling (MJM): working principle, Process, Applications, Advantages and Disadvantages, Case studies.

UNIT-III

Powder Based AM Systems: Selective laser sintering (SLS): Principle, process, Indirect and direct SLS- powder structures, materials, post processing, surface deviation and accuracy, Applications. Case studies. 9

Laser Engineered Net Shaping (LENS): Process, working principle, Applications, Advantages and Disadvantages, Case studies.

Other Additive Manufacturing Systems:

Three-dimensional Printing (3DP): Principle, basic process, Physics of 3DP, types of printing, process capabilities, material system. Solid based, Liquid based, and powder based 3DP systems, strength and weakness, Applications, and case studies. Shape Deposition Manufacturing (SDM), Ballastic Particle Manufacturing (BPM), Selective Laser Melting, Laser Beam based Powder Bed Additive Manufacturing, Electron Beam based Powder Bed Additive Manufacturing.

UNIT-IV

AM Data Formats: Reengineering for Digital Representation, STL Format, STL File Problems, Consequence of Building Valid and Invalid Tessellated Models, STL file Repairs: Generic Solution, Other Translators, Newly Proposed Formats. Mesh Refining by Subdivision Techniques. 9

AM Software's: Need for AM software, Features of various AM software's like MAGICS, Mimics, Solid View, View Expert, 3 D View, Velocity 2, Rhino, STL View 3 Data Expert and 3 D doctor, 3-matic, MeshLab.

Text and Reference books

1. Gibson, I., Rosen, D.W. and Stucker, B., "Additive Manufacturing Methodologies: Rapid Prototyping to Direct Digital Manufacturing", Springer, 2010.
2. Chua, C.K., Leong K.F. and Lim C.S., "Rapid prototyping: Principles and applications", second edition, World Scientific Publishers, 2010.
3. Kamrani, A.K. and Nasr, E.A., "Rapid Prototyping: Theory and practice", Springer, 2006.
4. Hilton, P.D. and Jacobs, P.F., Rapid Tooling: Technologies and Industrial Applications, CRC Press, 2005.

BME-326 Design of Mechatronic Systems

Course Category	:	Program Elective (PE1)
Pre-requisites	:	NIL
Contact Hours/Week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and one Major Theory Examination
Course Objectives	:	It aims to provide students with knowledge, skills, and exposure to the integrated design process of mechatronics systems. The subject also provides wider background knowledge of mechatronics, exposing students to current state-of-the-arts and challenges.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Understand the elements of mechatronics system and its applications.
2. Understand the integrated mechanical-electronics design philosophy.
3. Understand the basic building blocks of microprocessors.
4. Understand the microcontroller and philosophy of programming interfaces

5. Understand the mathematical modelling of mechatronics systems.
6. Understand the selection of sensors and actuators and feedback and closed loop control.

Topics Covered

UNIT-I 9

Introduction: Elements of mechatronics system: Sensor, actuator, plant, and controller. Applications of mechatronics system. Systems like CDROM, scanner.

Integrated mechanical-electronics design philosophy. Examples of real-life systems. Smart sensor concept and utility of compliant mechanisms in mechatronics

Microprocessor building blocks, combinational and sequential logic elements, memory, timing and instruction execution fundamentals with example of primitive microprocessor.

UNIT-II

Microcontrollers for mechatronics: Philosophy of programming interfaces, setting sampling time, and Getting started with TIVA programming **9**

Microcontroller programming philosophy emphasis on TIVA, programming different interfaces PWM, QEI etc.

UNIT-III **9**

Mathematical modelling of mechatronic systems, Modelling friction, DC motor, Lagrange formulation for system dynamics. Dynamics of 2R manipulator, Simulation using MATLAB,

UNIT-IV **9**

Selection of sensors and actuators. Concept of feedback and closed loop control, mathematical representations of systems and control design in linear domain. Basics of Lyapunov theory for nonlinear control, notions of stability, Lyapunov theorems and their application. Trajectory tracking control development based on Lyapunov theory, Basics of sampling of a signal, and signal processing. Digital systems and filters for practical mechatronic system implementation. Research example/ case studies of development of novel mechatronics system: 3D micro-printer, Hele Shaw system for microfabrication.

Text and reference Books:

1. Devdas Shetty, Richard A. Kolk, "Mechatronics System Design," PWS Publishing company
2. Boukas K, Al-Sunni, Fouad M "Mechatronic, Systems Analysis, Design and Implementation," Springer,
3. Sabri Cetinkunt, "Mechatronics with Experiments," 2nd Edition, Wiley
4. Janschek, Klaus, "Mechatronic Systems Design," Springer

BME-327 **Computational Continuum Mechanics**

Course Category	:	Program Elective (PE1)
Pre-requisites	:	NIL
Contact Hours/Week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and one Major Theory Examination
Course Objectives	:	The course is designed to introduce the fundamentals of continuum mechanics and to demonstrate how problems in continuum mechanics can be solved using mathematical techniques.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Understand the origins of nonlinearity, tensor algebra and tensor analysis
2. Understand the concept of deformation gradient, polar decomposition and linearized kinematics.
3. Understand Cauchy stress tensor, equilibrium equations and principle of virtual work.
4. Understand the concept of work conjugacy, different stress tensors and Stress rates.
5. Understand the concept of Hyper elasticity through Lagrangian and Eulerian elasticity tensor
6. Apply the concept of linearization and discretization.

Topics Covered

Unit-I **9**

Introduction – origins of nonlinearity,
Mathematical Preliminaries -1: Tensors and tensor algebra,
Mathematical Preliminaries -2: Linearization and directional derivative, Tensor analysis.
Kinematics – 1: Deformation gradient, Polar decomposition, Area and volume change
Kinematics – 2: Linearized kinematics, Material time derivative, Rate of deformation and spin tensor

UNIT-II **9**

Kinetics – 1: Cauchy stress tensor, Equilibrium equations, Principle of virtual work
Kinetics – 2: Work conjugacy, Different stress tensors, Stress rates

UNIT-III **9**

Hyper elasticity - 1: Lagrangian and Eulerian elasticity tensor
Hyper elasticity - 2: Isotropic hyper elasticity, Compressible Neo-Hookean material

UNIT-IV **9**

Linearization: Linearization of internal virtual work, Linearization of external virtual work
Discretization: Discretization of Linearized equilibrium equations – material and geometric tangent matrices, Solution Procedure: Newton-Raphson procedure, Line search and Arc length method

Text and reference Books

1. Nonlinear Solid Mechanics for Finite Element Analysis: Statics by J. Bonet A. J. Gil and R. D. Wood, Cambridge University Press, 2016
2. Finite Element Procedures by K.-J. Bathe Prentice-Hall India, New Delhi, 1996.
3. Applied Mechanics of Solids by A. F. Bower, CRC Press, Boca Raton, 2010. (Also accessible through authors website: http://solidmechanics.org/)

BME-328 **Elements of Solar Energy Conversion**

Course Category	:	Program Elective (PE-1)
Pre-requisites	:	NIL
Contact Hours/Week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and one Major Theory Examination
Course Objectives	:	This subject provides fundamentals of solar radiation, its availability, geometry of solar radiation and procedure to evaluate its availability It will develop critical thinking and reasoning about issues associated direct and indirect use of solar energy

Course Outcomes : The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Understand the basic concepts related to solar radiation and solar time.
2. Understand the concepts of angle of incidence on a tilted plane, shading, sun-path diagram.
3. Understand solar collectors, measurement of radiation and estimation of total irradiance on a tilted surface.
4. Understand the concept of air heaters and thermal analysis of air heaters
5. Understand the classifications of concentrators and its thermal analysis
6. Understand the Non-thermal routes for solar energy conversion

Topics Covered

UNIT-I 9

Basic concepts related to solar radiation, the sun, spectral distribution, sun- earth relationship, extra-terrestrial radiation, revolution of earth, seasons, position of sun in the sky, position of sun with respect to the centre of the earth

Concept of time, equation of time, solar time, standard time, Role of atmosphere on solar radiation, air mass, terrestrial spectrum, prediction of solar radiation

UNIT-II 9

Diffuse and direct radiation, derivation of the relationships between angles. Sign conventions, angle of incidence on a tilted plane, shading, sun-path diagram, overhangs, parallel rows of solar collectors, measurement of radiation. Estimation of total irradiance on a tilted surface, radiation augmentation. Flat plate collector, thermal analysis, heat removal factor.

UNIT-III 9

Air heaters, thermal analysis of air heaters, overview of other thermal collectors, testing procedure. Single axis tracking, concentrating collectors, theoretical limit, classifications of concentrators. Parabolic trough collector, thermal analysis, compound parabolic concentrators, parabolic dish collector, central receiver tower

UNIT-IV 9

Non-thermal routes for solar energy conversion, Basics of photovoltaic effect, Electron-hole carrier formation and motion. Band bending, photovoltaic generation, P-N junction diode, forward Bias, reverse bias. Dark current, light-generated current, IV characteristic curve for P-N junction diodes, efficiency, effect of temperature intensity and spectrum, Comparative discussion on different solar conversion technologies in the state-of-the-art form and the future directions

Text and reference books

1. Solar Engineering of Thermal Processes, 4th Ed, Duffie and Beckman,Wiley
2. Solar Energy, 4th Ed, Sukhatme and Nayak, McGraw-Hill Education
3. Solar Photovoltaics, 3rd Ed, Solanki, PHI learning pvt. Ltd.
4. Solar Energy Engineering, 2nd Ed, Kalogirou, Academic Press
5. Solar Energy, 1st Revised ed, Garg- Prakash, McGraw-Hill Education

BME-329 **Dynamic Behaviour of Materials**

Course Category	:	Program Elective (PE-1)
Pre-requisites	:	NIL
Contact Hours/Week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and one Major Theory Examination

Course Objectives :

To introduce students to the mechanical behavior of materials and the associated deformation/failure mechanisms under high-rate loading.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Understand dynamic deformation and failure.
2. Understand the types of elastic waves, Plastic waves and shock waves.
3. Understand explosive-material interaction and detonation
4. Understand the elastic and plastic deformation of metals
5. Understand the plastic deformation of metals at high strain rates
6. Understand the fundamentals of fracture mechanics, crack branching and dynamic fracture.

Topics Covered

UNIT-I 9

Introduction: dynamic deformation and failure. Introduction to waves: elastic waves; types of elastic waves; reflection, refraction, and interaction of waves. Plastic waves and shock waves: Plastic waves of uniaxial stress, uniaxial strain, and combined stress; Taylor's experiments.

UNIT-II 9

Shock waves. Shock wave induced phase transformation; Explosive-material interaction and detonation. Experimental techniques for dynamic deformation: intermediate strain rate tests; split Hopkinson pressure bar; expanding ring test; gun systems. Review of mechanical behaviour of materials (especially metals): Elastic and plastic deformation of metals; dislocation mechanics.

UNIT-III 9

Plastic deformation of metals at high strain rates: Empirical constitutive equations; relationship between dislocation velocity and applied stress; physically based constitute equations. Plastic deformation in shock waves: Strengthening due to shock wave propagation; dislocation generation; point defect generation and deformation twinning. Strain localization/shear bands: Constitutive models; metallurgical aspects

UNIT-IV 9

Dynamic Fracture: Fundamentals of fracture mechanics; limiting crack speed, crack branching and dynamic fracture. toughness; spalling and fragmentation. Dynamic deformation of materials other than metals: Polymers; ceramics; composites. Applications: Armor applications; explosive welding and forming

Books and references

1. Marc A. Meyers, Dynamic Behavior of Materials, John Wiley & Sons, New York, 1994
2. L.B. Freund, Dynamic Fracture Mechanics, Cambridge, 1990
3. Y. Bai B. Dodd, Adiabatic Shear Localization, Pergamon, Oxford, UK, 1992
4. G.E. Dieter, Mechanical Metallurgy, Mc Graw Hill, 1986
5. J.W. Swegle, D.E. Grady, in Shock Waves in Condensed Matter- 1985,
6. Y.M. Gupta, Plenum, New York, 1986

BME-304		**Principles of Industrial Engineering**
Course Category	:	Program Core (PC)
Pre-requisites	:	NIL
Contact Hours/Week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment Methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two Minor tests and One Major Theory
Course Objectives	:	The course content provides a systematic and comprehensive understanding on various aspects related with industrial engineering and its relevance in the industrial environment. It includes organizational structure, plant location and plant layout, production planning and control, scheduling, forecasting, work study, method study and work measurement, ergonomics.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge and skills after completing this course

1. Understand the Concept, Function and Application of industrial engineering, production and productivity, measurement of productivity, work study, work sampling.
2. The knowledge of job evaluation and analysis, wage-incentive payment plans, materials Handling,
3. Understand the objectives and functions of production planning and control, Break-Even Analysis.
4. The understanding of depreciation and service life of assets.
5. Understand the concept of Inventory control, process control, Control Charts, acceptance plan and acceptance sampling.
6. Understand the concept and importance of organization, organizational structure, Organizational chart, Sole/proprietary enterprise, labour legislation, factory act, wage and insurance act.

Topics Covered

UNIT-I

Introduction 9

Concept of Industrial Engineering, Function of industrial engineering, Industrial engineering techniques, Role of industrial engineer. Application of industrial engineering

Production and Productivity

Concept of production, production function, production system, definition of productivity, difference between productivity and production, productivity efficiency and effectiveness, measurement of productivity, Types of productivity, productivity index, ways to improve productivity.

Work study

Definition and concept, objectives of work study, purpose and procedure of method study, analysis of motion, micromotion study, motion economy principles, flow chart, man-machine chart, PMTS, work measurement, stop- watch time study, performance rating, standard time, work sampling

UNIT-II

Job Evaluation & Merit rating 9

Concept of job evaluation, Job analysis, Job description, job simplification, job evaluation methods. Definition and methods of merit rating, wage-incentive payment plans.

Plant layout and materials Handling

Considerations in Plant location, definition of plant layout, types of layouts, principles of Plant layout, material handling equipment

Production planning and control

Objectives of PPC, Functions of PPC, production planning, steps in PPC, Effectiveness of PPC system

Break-Even-Analysis

Introduction and purpose of BEA, Margin of safety, Angle of incidence, Profit volume graph.

UNIT-III

Depreciation and Replacement 9

Concept of depreciation, obsolescence, classification of depreciation, method of charging depreciation, service life of assets, Replacement of items.

Inventory Control

Inventory, function of inventory, inventory cost, deterministic inventory models

Statistical Quality Control

Introduction, process control, Control Charts, acceptance plan, acceptance sampling, single, double& sequential sampling plans, concept of average outgoing quality.

UNIT-IV

Organization 9

Concept and importance of organization, Principles of organization, organizational structure, Design of organization, Organizational chart.

Industrial Ownership

Sole/proprietary enterprise, partnership firm, Joint stock company, classification of company, comparison of public, private and joint sector, & co-operative organization.

Factory legislation in India

Importance and principles of labour legislation, factory act, payment of wages act, minimum wages act, workmen‘s compensation act, employee‘s state insurance act.

Text and reference books:

1. Production Management- S. K. Hajara Choudhary, Nirjhar Roy and A. K. Hajara Choudhary (Media Promoters and Publisher)
2. Production and Operation Management - Adam and Ebert (Pearson Education Asia)
3. Modern Production/operations Management- Buffa (Wiley Eastern, New York).
4. Industrial Engineering and operations management- S.K. Sharma & Savita Sharma (SK Kataria & sons)
5. Industrial Engineering – A.P. Verma (SK Kataria & sons)
6. Industrial Engineering – M.I. Khan (New Age International)
7. Industrial Engineering – S. Seetharaman & B. Vijayaramnath (Umesh Publications)
8. Industrial Engineering and Management – O.P. Khanna (Dhanpat Rai Publications)

BHM-302/352 INDUSTRIAL MANAGEMENT

Course category : BHM

Pre-requisite Subject : NIL

Contact hours/week	:	Lecture: 2, Tutorial: 0, Practical: 0
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives		The course is aimed to develop the mathematical skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Students will become efficient and acquire acumen for more profitable business practices.
2. Students will understand the importance of better customer service and product quality.
3. Able to make work safer, faster, easier, and more rewarding.
4. Able to help the industry in the production of more products that possess all utility factors
5. Reducing costs associated with new technologies.
6. Able to understand different principle of Industrial Management.

Topics Covered

UNIT-I 6

Introduction of Modern Management: Definition, Nature and Scope of Management, Process of Management, Elements of Management, Definition of Industrial Management, Scope and Application of Industrial Management.

Plant Location and Layout: Factors affecting Plant Location, Objectives and Principles of Plant Layout, Types of Plant-Layout

UNIT-II 6

Work Analysis and Measurement: Design of work Study, Steps involved in Work-study process, Definition and Concept of Method study, Procedure involved in Method Study, Objectives and techniques of Work Measurement, Work sampling and its application, Selection of Personnel and wage payment plans.

UNIT-III 6

Organizational Structures: Types of organizations, Functions, and objectives of industrial organizations, Ownership of Industries; Proprietorship, Partnership, Joint-stock companies, Public and Private undertakings, Co-operative organizations. Sources of finance, Types of Bank accounts.

UNIT-IV 6

Material Management: Meaning of Inventory management, Economic Order Quantity (EOQ) Model, ABC analysis, Just-in-time (JIT), Minimum Safety Stock

Industrial Safety: Occupational safety, safety programs; Safety aspects in work system design

Text & Reference books:

1. P. Crowson. Economics for Managers, Macmillan, London.
2. J. Russell (Joseph Russell) Smith, "The Elements of Industrial Management", Hard Press
3. Rieske, David W., Asfahl and C. Ray, "Industrial Safety and Health Management", 6th Ed., Prentice Hall Professional Technical Ref.
4. Gavriel Salvendy, "Handbook of Industrial Engineering: Technology and Operations Management", John Wiley & Sons, Inc.
5. Herman B. Henderson, Albert E. Haas, "Industrial Organization and Management Fundamentals", Industrial Press, The University of California.

BSM-352 REFRIGERATION& AIR CONDITIONING

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination & Practical Examination
Course Objectives		The course is aimed to develop the mathematical skills and analyzing different situations in the industrial scenario having limited resources and obtain the optimal solution with and without constraints.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand the refrigeration principles, air refrigeration cycles and introduction to the different refrigerants.
2. Understand the knowledge of single stage vapour compression refrigeration system and multi-pressure refrigeration system and performance calculations.
3. Understand the knowledge of vapour absorption refrigeration systems.
4. Introduction to the psychrometry in air conditioning systems.
5. Understand the designing of air conditioning systems
6. Introduction to various refrigerating equipment and its application.

Topics Covered

UNIT-I 9

Refrigeration: Introduction to refrigeration system, Methods of refrigeration, Unit of refrigeration, Refrigeration effect &C.O.P, Carnot refrigeration vapour cycle.

Air Refrigeration cycle: Open and closed air refrigeration cycles, Reversed Carnot gas cycle, Bell Coleman or Reversed Joule air refrigeration cycle, Aircraft refrigeration system, Different aircraft refrigeration systems, DART.

Refrigerants: Classification of refrigerants, Nomenclature, Desirable properties of refrigerants, Common refrigerants, secondary refrigerants, ODP and GWP, CFC free refrigerants

UNIT-II 9

Vapour Compression System: Single stage system, Analysis of vapour compression cycle, use of T-S and P-H charts, Effect of suction and discharge pressures on C.O.P, Effect of sub-cooling of condensate &superheating of refrigerant vapour on C.O.P of the cycle, Actual vapour compression refrigeration cycle, Multistage vapour compression system requirement, Removal of flash gas and Intercooling, Different configuration of multistage system, Multi evaporator refrigeration systems, Cascade system.

UNIT-III 9

Vapour Absorption system: Working Principle of vapour absorption refrigeration system, Comparison between absorption &compression systems, Elementary idea of refrigerant absorbent mixtures, Temperature–concentration diagram, Ammonia –Water vapour absorption system, Lithium- Bromide water vapour absorption system.

Air Conditioning-I

Introduction to air conditioning, Psychometric properties and their definitions, Psychometric chart, Different Psychometric processes, Thermal analysis of human body, Effective temperature and comfort chart.

UNIT-IV 9

Air Conditioning- II: Cooling and heating load calculations, Selection of inside & outside design conditions, Heat transfer through walls & roofs, Infiltration &ventilation, Internal heat gain, Sensible heat factor (SHF), By pass factor, Grand Sensible heat factor(GSHF),Apparatus dew-point (ADP). Introduction to desiccant cooling.

Refrigeration Equipment& Applications: Elementary knowledge of refrigeration &air conditioning equipment's, e.g., compressors, condensers, evaporators &expansion devices, Air washers, Cooling, towers & humidifying efficiency, Food preservation, Cold storage , Refrigerates Freezers, Ice plant, Water coolers ,Elementary knowledge of transmission and distribution of air through ducts.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the following

1. Experimentation vapour compression refrigeration test rig and calculation various performance parameters.
2. Experiment on vapour absorption refrigeration test rig and analysis of various performance parameters.
3. Experiment on cascade refrigeration test rig and analysis of various performance parameters.
4. Experiment on water-to-water heat pump and analysis of various performance parameters.
5. To study different types of expansion devices used in refrigeration system.
6. To study basic components of air-conditioning system and experiment on air-conditioning test rig& calculation of various performance parameters.
7. To study air washers

Text & Reference books:

1. Refrigeration and Air conditioning- Manohar Prasad (New Age International(P)Ltd)
2. Refrigeration and Air conditioning-C. P Arora (Tata Mc Graw Hill).
3. Refrigeration and Air conditioning –Arora & Domkundwar (Dhanpat Rai &Co.(p)Ltd, Delhi).
4. Refrigeration and Air conditioning - Stoecker & Jones (McGraw-Hill Education India Pvt. Ltd –New Delhi).
5. Principle of Refrigeration-Roy J. Dossat (Pearson).
6. Refrigeration and Air conditioning-P.L. Baloney (Khanna).
7. Thermal Environment Engineering-Kuhen, Ramsey &Threlkeld (PrenticeHall)
8. Performance studies of desiccant cooling systems - P. Rai, S.K. Shukla (Lambert publication Germany).

BME-353 INTERNAL COMBUSTION ENGINE

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, Two Minor tests, and One Major Theory & Examination
Course Objectives	:	This course studies the fundamentals of how the design and operation of internal combustion engines affect their performance, efficiency, fuel requirements, and environmental impact.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

COURSE OUTCOMES

1. Can explain fuel supply systems, combustion and emission aspects of IC engines, and recent developments in IC engines.
2. Able to design fuel and air supply systems and combustion and after-treatment systems
3. Able to apply knowledge in developing engine combustion and exhaust treatment models
4. Can explain advanced engine technologies such as MPFI, GDI, HCCI
5. Calculate the stoichiometric air-fuel ratio and enthalpy of combustion that is applied in IC engines.
6. Apply concepts of different alternate fuels used for SI and CI engines

Topics Covered

UNIT-I

Introduction: Classification of IC engines, working cycles, comparison of two strokes & four-stroke engines, Comparison between SI & CI engines. Fuel combustion &Fuel injection: Structure & composition of IC engine fuel, Fuel rating properties of the fuel, fuel additives. Fuel air requirement for ideal normal operation, maximum power & quick acceleration, simple carburetor & its drawback. Practical carburetor, petrol injection. Requirements & type of diesel injection system, fuel pump, injectors & nozzles. 9

UNIT-II

Ignition &combustion in IC Engines: Battery, magneto & Electronic ignition systems, Ignition timing, spark advance mechanism. Stages of SI engine combustion, Effect of engine variables on ignition lag flame front propagation. Abnormal combustion, preignition & detonation, Theory of detonation, Effect of engine variables on detonation, Control of detonation. Requirement of good combustion chambers for SI engines. Stages of CI engine combustion. Effect of engine variables on delay periods. Diesel Knock & methods of control in CI engine combustion chambers. 9

UNIT-III

Testing and performance: Power, Fuel, and air measurement methods, the performance of SI and CI Engines, Characteristics curve. Variables affecting performance and methods to improve engine performance Cooling and Lubricating Systems, Engine Emission & Controls: Air cooling and Water-cooling system, Effect of cooling on power output & efficiency, properties of lubricants &types of lubricating system engine emission & its harmful effect. Methods of measuring pollutants and control of engine emission. 9

UNIT-IV

Introduction to alternate fuels-biofuels, thermochemical and biochemical conversion, Vegetable oils and Biodiesel, Ethanol, LPG, Natural gas, Hydrogen-Production, and Utilization perspective. 9

Text & Reference Books:

1. Fundamentals of Internal Combustion Engine - Gill, Smith, Ziurs (Oxford & IBH Publishing Co.)
2. IC Engines – Rogowsky (International Book Co.)
3. Internal Combustion Engine and Air Pollution- E.F Obert (Harper & Row, New York)

4. A Course in International Combustion Engines - Mathur & Sharma (Dhanpat Rai & Sons) 5. I.C Engine – Ganeshan (Tata McGraw Hill)
5. I.C Engine - R. Yadav (Central Publishing House)
6. Turbines, Compressors and Fans - S.M. Yahya (Tata McGraw Hill) 8. Fundamentals of Combustion – D. P. Mishra (PHI Leaning Pvt. Ltd.)

BME-376 **MECHANICAL VIBRATIONS**

Course category : Program Elective-2 (PE- 2)
Pre-requisite Subject : NIL
Contact hours/week : Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits : 4
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives : The objective of this course is to learn how to treat the vibration phenomena by transforming the physical model into a mathematical model and solve it by using the appropriate mathematical operations to find the response and analyze this response and bring it back to its physical concept
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Understand different types of vibration and mathematical analysis of single degree freedom system under free vibration and damped vibration.
2. The mathematical analysis of single degree freedom system subjected to forced vibration; understand the principles and working of vibration measuring instruments and able to calculate the critical speeds of shaft.
3. Understand the analysis of two-degree freedom system under free, damped and forced vibrations and principle and working of different types of vibration absorbers.
4. The ability to carry out exact and numerical analysis of multi degree freedom system subjected to different types of vibration.
5. The students should be able to define, design and solve any type of vibration problems.
6. The student should be able to understand the significance of mechanical vibration.

Topics Covered

UNIT-I 9

Introduction Periodic motion, Harmonic motion, Superposition of simple harmonic motions, Beats, Fourier analysis Single Degree Freedom System: Free Vibration Free vibration-spring mass system, torsional system, Natural frequency, Equivalent systems, Energy method for determining natural frequency, Response to an initial disturbance, Phase plane method Single Degree Freedom System: Damped Vibration Damping models, Vibrations of spring-mass system with viscous damping, Logarithmic decrement

UNIT-II 9

Single Degree Freedom System: Forced Vibration Forced vibration, Harmonic excitation with viscous damping, steady state vibrations, Forced vibrations with rotating and reciprocating unbalance, Support excitation, Vibration isolation, Force Transmissibility, Vibration measuring instruments, Displacement, velocity and acceleration measuring instruments Critical Speed of Shaft with one disc with and without damping, Multi-disc shafts, Secondary critical speed

UNIT-III 9

Two Degree Freedom systems Introduction, Free vibration-spring-mass system, principal modes, double pendulum, torsional system, Coupled rectilinear and angular modes, Damped Vibration-spring-mass system, Force vibration-spring mass system with harmonic excitation Vibration absorbers Introduction, Undamped dynamic vibration absorber, Torsional absorber, Centrifugal pendulum absorber, Dry friction damper

UNIT-IV 9

Multi Degree Freedom system: Exact Analysis Undamped free and forced vibrations of multi-degree freedom systems, influence number, Maxwell's reciprocal theorem, Torsional vibration of multi-degree rotor system, Principal coordinates, Continuous systems longitudinal vibrations of bars, torsional vibrations of circular shafts Multi Degree Freedom system: Numerical Analysis Rayleigh's, Dunkerely's, Holzer's and Stodola methods

Text & Reference Books:

1. Elements of Vibration Analysis– L. Meirovitch (McGraw-Hill Company)
2. Mechanical Vibrations – P. Srinivasan (Tata McGraw Hill)
3. Mechanical Vibrations – G. K. Grover (Jain Brothers, Roorkee)
4. Mechanical Vibrations – W. T. Thomson (George Allen & Unwin)
5. Theory and Practice of Mechanical Vibrations – J S Rao & K Gupta (New Age International)
6. Mechanical Vibrations – Tse, Morse & Hinkle (CBS Publishers & Distributors Pvt. Ltd)
7. Mechanical Vibrations – V. Rama Murthy (Narosa Publications)
8. Mechanical Vibrations- V. P. Singh (Dhanpat Rai & Co.)

BME-377 PRINCIPLES OF MACHINE TOOLS DESIGN

Course category	:	Program Electives (PE- 2)
Pre-requisite Subject	:	Manufacturing Science
Contact hours/week	:	Lecture: 3, Tutorial: 1 , Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The course provides details about various machine tool drives and its regulation and transmission. Students will learn the general requirement of machine tool design & process, tool wear, force analysis.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The knowledge of developments in machine tools, construction and operations of basic machine tools, tool wear and force analysis.
2. Understand the elements of mechanical and hydraulic transmission system, fundamental of kinematic structure of machine tools.
3. Demonstrate an understanding of regulation of speed, feed rates and design of machine tool structure – bed, column and housing.
4. The knowledge of designing guide ways and power screw, dynamic stability of cutting process, machine tool installation and maintenance.
5. The students should be able to define and design machine tools.
6. The student should be able to understand the general requirement of machine tool design.

Topics Covered

UNIT-I 9

Introduction Developments in machine tools, surface profiles and path produced by machine tools, features of construction and operations of basic machine tools such as lathe, drill, milling, shaper and grinding machine, General requirement of machine tool design & process, tool wear, force analysis.

UNIT-II 9

Machine Tools Drives Classification of machine tool drives, group & individual drives, selection of electric motor, A brief review of the elements of mechanical transmission such as gear, belt, and chain drives, slider crank mechanism, cam mechanism, nut and screw transmission, devices for intermittent motion, reversing & differential mechanisms, Coupling and clutches. Elements of hydraulic transmission system- pumps, cylinder, directional valves, pressure valves etc. Fundamentals of Kinematic structure of machine tools

UNIT-III 9

Regulation of Speed and Feed rates Laws of stepped regulation, selection of range ratio, standard progression ratio, selection of best possible structural diagram, speed chart, Design of feed box, Developing gearing diagrams. Stepless regulation of speed and feed in machine tools. Design of Machine Tool Structure Requirements and design criteria for machine tool structures. Selection of material ‘s Basic design procedure for machine tool structures—bed, column & housing

UNIT-IV 9

Design of Guideways and Power Screws Basic guideway profiles. Designing guideways for stiffness a wear resistance & hydrostatic and antifriction guideway. Design of sliding friction power Screws. Design of spindlier & spindle supports. Layout of bearings, selection of bearings machine tools. Dynamics of Machine Tools General procedure for assessing the dynamic stability of cutting process, closed loop system, chatter in machine tools. Machine tool installation and maintenance

Text & Reference books:

1. Machine Tools Design & Numerical Controls –N.K. Mehta (Tata McGraw Hill)
2. Design of Machine Tools – S.K. Basu (Allied Publishers)
3. Principles of Machine Tools – A. Bhattacharya and G.C. Sen (New Central book Agency)
4. Machine Tool Design Handbook (CMTI, Bangalore

BME-378 TOTAL QUALITY MANAGEMENT

Course category	:	Programme Electives (PE2)
Pre-requisite Subject	:	--
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The overall purpose of the course is to provide an understanding of the process of managing quality and managing services. It includes the principles of Quality, Quality Assurance. It will provide an insight into the concepts of Excellence and Best Value and the contribution of quality to strategic management.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Acquire the basic knowledge of quality and its evolution.
2. The knowledge of Organization structure and design and Total Quality Management principles for continuous improvement.
3. The understanding of quality management tools to evaluate the quality.
4. The knowledge of ISO-9000, ISO 14000 and TQM implementation.
5. The students should be able to understand evolution of quality.
6. The student should be able to understand continuous process improvement.

Topics Covered

UNIT-I 9

Quality Concepts Introduction, need for quality, evolution of quality; Definitions of quality, product quality and service quality; Methods and techniques for inspection and control of product, Basic concepts of TQM, TQM framework, contributions of Deming, Juran and Crosby. Barriers to TQM; Quality statements, customer focus, customer orientation & satisfaction, customer complaints, customer retention; costs to quality.

UNIT-II 9

TQM principles Organization structure and design, Leadership, strategic quality planning; Quality councils employee involvement, motivation; Empowerment; Team and Teamwork; Quality circles, recognition and reward, performance appraisal; Continuous process improvement; PDCA cycle, 5S, Kaizen; Supplier partnership, Partnering, Supplier rating & selection.

UNIT-III 9

Quality Management Tools The seven traditional tools of quality; New management tools; Six sigma- concepts, methodology, applications to manufacturing, service sector including IT, Bench marking process; FMEA- stages, types. TQM tools and techniques, control charts, process capability, concepts of six sigma, Quality Function Development (QFD), Taguchi quality loss function; TPM- concepts, Building Reliability in product, evaluation of reliability.

UNIT-IV 9

Quality systems Need for ISO 9000, ISO 9001-9008; Quality system- elements, documentation, Quality auditing, QS 9000, ISO 14000- concepts, requirements and benefits; TQM implementation in manufacturing and service sectors.

Text & Reference Books:

1. Total Quality Management- Besterfield D.H. et al, Pearson Education Asia.
2. The Management and Control of Quality- Evans J.R. and Lindsay W.M., Cengage Learning.
3. TQM in new Product Manufacturing- Menon, H.G., McGraw Hill.
4. Total Quality Management- Janakiraman B. and Gopal R.K., Prentice Hall India.
5. Total Quality Management- Suganthi L. and Samuel A., Prentice Hall India.

BME-379 RENEWABLE ENERGY TECHNOLOGIES

Course category	:	Programme Electives (PE2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	Introduce about the renewable energy sources like wind, solar and wave energy. Impart knowledge about the environmental friendly energy production and consumption.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The importance and applications of renewable energy sources their utilization and collection of solar energy.
2. Student will be able to understand the application of solar energy and wind energy, its conversion, performance analysis of different solar collectors and solar photovoltaic system.
3. The understanding of photosynthesis, biogas production aerobic and anaerobic bio conversion process, biogas applications and energy recovery from urban waste and biomass resource development in India.
4. The knowledge of the fundamentals and application of tidal power, ocean thermal energy, wave energy, geothermal energy and hydro energy.
5. The student should be able to understand the significance of bio-mass energy.
6. The student should be able to understand the practical application of different energy resources.

Topics Covered

UNIT-I 9

Energy resources Introduction to various sources of energy, Solar thermal, Photovoltaic, Waterpower, Wind energy, Biomass, Ocean thermal, Tidal and wave energy, Geothermal

energy, Hydrogen energy systems, Fuel cells, Decentralized and dispersed generation. Solar Energy Sun as Source of Energy, Availability of Solar Energy, Nature of Solar Energy, Solar Energy & Environment. Various Methods of using solar energy –Photothermal, Photovoltaic, Photosynthesis, Present & Future Scope of Solar energy. Collection of Solar Energy Solar thermal power and it's conversion, Solar collectors, Flat plate, Performance analysis of flat plate collector, Solar concentrating collectors, Types of concentrating collectors, Thermodynamic limits to concentration, Cylindrical collectors, Thermal analysis of solar collectors, Tracking CPC and solar swing.

UNIT-II 9

Solar Energy Applications Application of solar energy- Solar water and air heaters, distillation, drying of materials, power generation, cookers, solar refrigeration. Photo voltaic technology. Wind Energy Properties of wind, Availability of wind energy in India, wind velocity, Wind machine fundamentals, Types of wind machines and their characteristics, Horizontal and Vertical axis windmills, Elementary design principles, Coefficient of performance of a wind mill rotor, Aerodynamic considerations in wind mill design, Selection of a wind mill, Wind energy farms, Economic issues, Recent development.

UNIT-III 9

Bio-mass Energy Biomass: Generation and utilization, Properties of biomass, Agriculture Crop & Forestry residues used as fuels. Biochemical and Thermo-Chemical Conversion, Combustion, Gasification, Biomass gasifiers and types etc., Applications of Gasifiers to thermal power and Engines, Biomass as a decentralized power generation source for villages. Fuel Cell Fuel cell – Principle of working, construction and applications.

UNIT-IV 9

Geothermal Energy, Geological setting, different geothermal systems, utilization of geothermal energy, its economic and environmental comparison. Brief description of different utilization techniques for ocean thermal energy, and tidal and wave energy. Hydel Energy Hydro power: Potential, Hydropower Generation and Distribution, Mini and Micro-hydel Power (MHP) Generation: Classification of hydel plants, Concept of micro hydel, merits, MHP plants: Components, design and layout, Turbines, efficiency, Status in India.

Books & References

1. Renewable Energy Sources and Conversion Technology -Bansal Keemann, Meliss (Tata McGraw Hill)
2. Renewable Energy Resources and Emerging Technologies - Kothari D.P. (Prentice Hall of India)
3. Nonconventional Energy - Ashok V. Desai (New Age International Publishers Ltd.)

BME-370		**PROJECT PART-I**
Course category	:	Project (P)
Pre-requisite Subject	:	Nil
Contact hours/week	:	Lecture: 0, Tutorial: 0, Practical: 4
Number of Credits	:	2

Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Objectives	:	To develop competency of applying engineering knowledge to real life problems.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Able to design the various component/subsystem of project using basic and advanced knowledge of science and engineering courses.
2. Able to analyze the various components/process of project problem.
3. Able to fabricate the hardware through different fabrication techniques available.
4. Able to make computer programme to design and analyze different components of product.
5. Able to write technical report by compiling the information
6. Able to derive conclusion of given project.

BME-380 **Seminar**

Course category	:	S
Pre-requisite Subject	:	Nil
Contact hours/week	:	Lecture: 0, Tutorial: 0, Practical: 4
Number of Credits	:	2
Course Assessment methods	:	Continuous assessment through three viva voce/presentation.
Course Objectives	:	To identify and compare technical and practical issues related to the area of course specialization.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Establish motivation for any topic of interest and develop a thought process for technical presentation.
2. Organize a detailed literature survey and build a document with respect to technical publications.
3. Demonstrate the ability to describe, interpret and analyze technical issues
4. Analysis and comprehension of proof-of-concept and related data.
5. Effective presentation and improve soft skills.
6. Make use of new and recent technology for creating technical reports

BME-401 **AUTOMOBILE ENGINEERING**

Course category	:	Program Core (PC)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	4

Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	The objective of this course is to impart knowledge to students in various systems of Automobile Engineering and to learn the fundamental principles, construction, and auxiliary systems of automotive engines
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Good knowledge of automotive components and machineries.
2. Ability to absorb the concerned problem at first instance and provide the suitable remedial measure to the problem.
3. Proficient in designing innovative projects and various transmission systems for fuel efficient engine.
4. Ability to demonstrate the various braking system and chassis & suspension system.
5. Ability to demonstrate the electrical systems like ignition, horn and battery.
6. Ability to demonstrate the fuel supply, air-conditioning, cooling and lubrication and maintenance systems.

Topics Covered

UNIT-I 9

Power Unit and Gear Box

Principles of Design of main components. Valve mechanism. Power and Torque characteristics. Rolling, air and gradient resistance. Tractive effort. Gear Box. Gear ratio determination, Design of Gear box.

UNIT-II 9

Transmission System

Requirements. Clutches. Torque converters. Over Drive and free wheel, Universal joint. Differential Gear Mechanism of Rear Axle. Automatic transmission, Steering and Front Axle, Castor Angle, wheel camber & Toe-in, Toe-out etc. Steering geometry. Ackerman mechanism, Understeer and Oversteer.

Vehicle stability- Stability analysis of the Linearlized model of vehicle, stability on a curve.

UNIT-III 9

Braking System

General requirements, Road, tyre adhesion, weight transfer, Braking ratio. Mechanical brakes, Hydraulic brakes. Vacuum and air brakes. Thermal aspects.

Chassis and Suspension System

Loads on the frame. Strength and stiffness. Various suspension systems.

Electrical System

Types of starting motors, generator & regulators, lighting system, Ignition system, Horn, Battery etc.

UNIT-IV 9

Fuel Supply System

Diesel & Petrol vehicle system such as Fuel Injection Pump, Injector & Fuel Pump, Carburettor etc. MPFI.

Automobile Air Conditioning

Requirements, Cooling & heating systems

Cooling & Lubrication System

Different type of cooling system and lubrication system

Maintenance system

Preventive maintenance, break down maintenance and over hauling.

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Study & experiment on Ignition system of I.C. Engine.
2. Study & experiment on Fuel Supply System of S.I. Engines- Fuel Injector/MPFI
3. Study & experiment on Fuel Supply System of C.I. Engines- Injector/CRDI.
4. Study & experiment on Valve mechanism.
5. Study & experiment on Gear Box.
6. Study & experiment on Differential Gear Mechanism of Rear Axle.
7. Study & experiment on Steering Mechanism.
8. Study & experiment on Automobile Braking System.
9. Study & experiment on Chassis and Suspension System.
10. Study & experiment on Air Conditioning System of an Automobile.
11. Comparative study of technical specifications of common small cars (such as Maruti Brezza, Hyundai Creta, Renault Kiger, Tata Tigor, Ford EcoSport etc.
12. Comparative study & technical features of common scooters & motorcycles available in India.
13. Visit of an Automobile factory.
14. Visit to a Modern Automobile Workshop.
15. Experiment on Engine Tuning.
16. Experiment on Exhaust Gas Analysis of an I.C. Engine
17. Determination of Indicated H.P. of I.C. Engine by Morse Test
18. Prepare the heat balance for Diesel Engine test rig
19. Prepare the heat balance sheet for Petrol Engine test rig

Text & Reference books:

1. Automotive Machines- Hietner (CBS Publisher)
2. Automobile Engineering - Kripal Singh (Standard).
3. Automobile Engineering – Narang (Khanna).
4. Automotive Mechanics- Crouse, Anglin (Career Education)
5. Motor Vehicle – Garrett, Newton and Steeds (Society of Automotive Engineers Inc).

BME-402 COMPUTER AIDED DESIGN

Course category	:	Program Core (PC)
Pre-requisites	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The main objective is to provide students with a conceptual understanding of the principles of CAD systems, the implementation of these principles, and its connections to CAM and CAE systems. The generic aspect of CAD software systems will be discussed. process.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. To get the knowledge of importance, benefits and engineering applications of CAD and integrated CAD/CAM systems.

2. To understand the graphics input, graphics display and graphics output devices and acquire the knowledge of graphics software, graphics standards, configuration, and functions.
3. To develop the skill of writing algorithm for generating 2D graphic elements such as line and circle.
4. To understand the concept and mathematics behind 2D & 3D individual and combined geometric transformations.
5. To develop the ability of mathematical representation of parametric form of analytic planar curves and synthetic space curves such as Hermite, Bezier and B-spline curves and knowledge of their properties.
6. To acquire the knowledge of polygonal, quadric and super quadric surfaces, blobby objects, colour models and skill of developing 3D geometric models in CAD software using different solid modelling techniques.

Topics Covered

UNIT-I 9

Introduction

Computer in Engineering design, Classical vs. Computer Aided Design, Elements of CAD, Essential requirements of CAD, CAD Tools, Concepts of integrated CAD/CAM, Necessity & benefits, Engineering Applications

Computer Graphics Hardware

Graphics systems, Graphics Input devices-cursor control devices, Digitizers, Image scanner, Speech oriented devices, Graphics display devices-Cathode Ray Tube, Calligraphic display, DVST, Raster display, Color frame buffer, Color CRT monitors, Solid state monitors-emissive displays, non-emissive displays, Graphics output devices- Hard copy printers and plotters

UNIT-II 9

Computer Graphics Software

Graphics Software, Software Configuration, coordinate system, Graphics software functions, viewing transformations-windowing and clipping, Graphics software standards

Output primitives

Scan conversion of primitives, Line generation algorithms-DDA and Bresenham's line drawing algorithm, Circle generating algorithm-Cartesian coordinates, Polar coordinates and Bresenham's algorithm

Geometric Transformations

2D Geometric Transformations - Translation, Scaling, Shearing, Rotation & Reflection Matrix representation-homogeneous coordinates, Rotation and scaling about arbitrary point, Reflection through arbitrary line, Composite transformation, 3 D transformations, multiple transformation

UNIT-III 9

Planar Curves

Curves representation, Interpolation vs approximation, Classical representation of curves, Parametric analytic curves-lines, circles, ellipses, parabolas, and hyperbolas

Space Curves

Properties for curve design, Parametric continuity, Parametric representation of synthetic curves, Spline curves and specifications, Parametric representation of synthetic curves, Hermite curves-Blending functions formulation, shape control, properties, Bezier curves-Blending

functions formulation, properties, Non-rational B-spline curves- Blending functions formulation, knot vector, B-spline blending functions, properties

UNIT-IV 9

3D Graphics

Introduction, Wireframe modelling, Surface modelling, Polygon surfaces-polygon meshes, polygon equations, Quadric and Super quadric surfaces, Blobby objects, Solid modelling-Boolean set operations, regularized set operations, Primitive instancing, Sweep representation-translational, rotational and hybrid sweeps, Boundary representation-topology, geometry, boundary models, Constructive solid geometry-unbounded and bounded primitives

Colour models

Colouring in computer graphics, RGB, CMY, YIQ, HSV and HLS colour models

Text & Reference Books:

1. Computer Graphics-Hearn & Baker (Prentice Hall of India)
2. Computer Aided Engineering Design-Anupam Saxena & B. Sahay (Anamaya Publishers)
3. CAD/CAM Theory and Practice- Ibrahim Zeid & R SivasubramaniamB(McGraw Hill)
4. Mathematical Elements for Computer Graphics- DF Rogers & JA Adams (McGraw Hill)
5. CAD/CAM-HP Groover & EW Zimmers, Jr (Prentice Hall India)
6. Computer Aided Design-S.K. Srivastava (IK International Publications)
7. Computer Aided Design-R.K. Srivastava (Umesh Publications)

BME-403 COMPUTER-AIDED MANUFACTURING

Course category : Program Core (PC)
Pre-requisite Subject : NIL
Contact hours/week : Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits : 4
Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination.

Course Objectives : To Introduce the students to the standard terminologies, conventions, processes, operations, design and operational characteristics of key hardware components, programming techniques, applications, merits and demerits of Computer Numerical Controlled (CNC) machines.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Ability to understand the application of computers in various aspects of Manufacturing.
2. Ability to understand automation principles and its implementation in manufacturing systems.
3. Understand fundamentals, suitability, and applications of CNC machine tools.
4. Ability to write manual part program and computer assisted part program for the production of components
5. Understand the utilities of Flexible manufacturing system and Industrial robot.
6. Ability to apply the concept of group technology and computer assisted process planning.

Topics Covered

UNIT-I 9

Introduction and Automation

Product design cycle and computer, CAM concepts, CAD/CAM interface, History of CAD/CAM, CAD/CAM in industry, Benefits of CAM, Impact of CAM on personnel.
Manual Manufacturing, Mechanization and Automation, Automated Manufacturing system- Hard, Programmable and Flexible automation, need of automation, Basicelements of automation, Level of automation, Automation principles and Strategies – USA principle, Ten strategies of automation of production system and automation migration strategy, Advantages & drawbacks of automation, Historical development and future trends.

UNIT-II 9

NC/CNC Machine Tools

Fundamental of Numerical Control, History of Numerical control, elements of NC machir classification of NC machine tools, Advantages, suitability and limitations of NC machir Application of NC system, Features of CNC machine tool, Machining center. CNC h recirculating ball screw, anti-friction slides, stepper and servo
motors. Feedback devices such as encoder, Interpolator – Linear and circular
Methods for improving Accuracy considering the factors such as tool deflection and chatter,
Methods for improving productivity, Adaptive control- Adaptive control with optimization, adaptive control with constraints

UNIT-III 9

CNC Part Programming:

Part programming fundamentals, Manual (word address format) programming for various machining operations such as Drilling, Turning and Milling; Preparatory functions. Miscellaneous functions, tool length and cutter radius compensation, canned cycles, Do loops, Subroutine, and Macro.
Concept of computer aided part programming, APT programming structure, Geometry commands, Motion commands and Post processor Commands, Macro- statement, Complete program in APT.

UNIT-IV 9

Group Technology & Computer Assisted Process Planning:

Introduction, part families, part classification and coding systems: OPITZ and PFA, composite part concepts, Benefits of group technology. Approaches to Process Planning, Different Computer aided process planning-Retrieval and Generative, application and benefits.
Flexible Manufacturing System: Introduction & Component of FMS, Needs of FMS, general FMS consideration, Objectives, Types of flexibility and FMS, FMS layout and advantages. Automated material handling system: Types and Application, Automated Storage and Retrieval System, Automated Guided Vehicles.

Robotics:

Types and generations of Robots, Structure and operation of Robot, Robot applications. Economics, Robot programming methods. VAL and AML with examples.

Intelligent Manufacturing

Introduction to Artificial Intelligence for Intelligent manufacturing.

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EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. To study the characteristics features of CNC lathe trainer.

2. To study the characteristics features of CNC Turning machine.
3. To study the characteristics features of CNC Milling machine.
4. To write Manual part program for a job for turning operation and prepare the component.
5. To prepare Manual part program for a job for drilling operation.
6. To write Manual part program for a job for milling operation and prepare the component.
7. Study of retrofitting.
8. Study of a pick and place robot.
9. Write a program for a pick and place robot to shift the work piece from one location to another.
10. To prepare a part program in APT for drilling operation.
11. To prepare a part program in APT for milling operation.

Text & Reference Books:

1. Automation, Production Systems and Computer Integrated Manufacturing by Mikell P. Groover (PHI)
2. Computer Aided manufacturing- P. N. Rao, N. K. Tewari & T. K. Kundra (Tata McGraw Hill).
3. CAD/CAM/CIM – P. Radhakrishnan, S. Subrmanyam and V. Raju (New Age International)
4. Computer Aided Manufacturing – Chang, Wysk and Wang (Pearson)
5. Computer Control of Manufacturing systems – Koren (McGraw Hill)
6. Numerical control and Computer aided manufacturing- - P. N. Rao, N. K. Tewari & T. K. Kundra (Tata McGraw Hill)
7. Computer Aided Design & Manufacture – C. B. Besant & C. W. K. Lui (East West Press)
8. NC Machines – S. J. Martin (English Language Book Society)
9. CAD/CAM – Ibraheim Zeid (Tata McGraw Hill)
10. CAD/CAM- P. N. Rao (Tata McGraw Hill)
11. Principles of Computer Integrated Manufacturing – S. Kant Bajpai (PHI)

BME-426 **POWER PLANT TECHNOLOGIES**

Course category	:	Programme Elective-3 (PE-3)
Pre-requisite Subject	:	Engineering Thermodynamics (BME-155)
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	To introduce students to different aspects of power plant engineering. To familiarize the students to the working of power plants based on different fuels and exposure to the principles of safety and environmental issues.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Ability to understand the various thermodynamic cycles and combustion in power plants
2. Explain the economics involved in Power Plant and identify the factors related to selection of plant

3. Acquire ability to discuss various components of steam power plant and the factors influencing the site selection for the plant
4. Describe the working of various components of diesel power plant and compare it with steam power plant.
5. Ability to illustrate the working of gas turbine power plant and its components.
6. Able to understand nuclear power plant and hydro-electric power plant with their components.

Topics Covered

UNIT-I

Introduction Power and energy, sources of energy, review of thermodynamic cycles related to power plants, fuels and combustion calculations. 9

Load estimation, load curves, various terms and factors involved in power plant calculations. Effect of variable load on power plant operation, Selection of power plant units.

Power plant economics and selection Effect of plant type on costs, rates, fixed elements, energy elements, customer elements and investor's profit; depreciation and replacement, theory of rates. Economics of plant selection, other considerations in plant selection

UNIT-II

Steam power plant General layout of steam power plant, Power plant boilers including critical and super critical boilers. Fluidized bed boilers, boilers mountings and accessories, Different systems such as coal handling system, pulverizers and coal burners, combustion system, draft, ash handling system, Dust collection system, Feed water treatment and condenser and cooling towers and cooling ponds, Turbine auxiliary systems such as governing, feed heating, reheating, flange heating and gland leakage. Operation and maintenance of steam power plant, heat balance and efficiency, Site selection of a steam power plant. 9

UNIT-III

Diesel power plant General layout, Components of Diesel power plant, Performance of diesel power plant, fuel system, lubrication system, air intake and admission system, supercharging system, exhaust system, diesel plant operation and efficiency, heat balance, Site selection of diesel power plant, Comparative study of diesel power plant with steam power plant. 9

Gas turbine power plant Layout of gas turbine power plant, Elements of gas turbine power plants, Gas turbine fuels, cogeneration, auxiliary systems such as fuel, controls and lubrication, operation and maintenance, Combined cycle power plants, Site selection of gas turbine power plant

UNIT-IV

Nuclear power plant Principles of nuclear energy, Lay out of nuclear power plant, Basic components of nuclear reactions, nuclear power station, nuclear waste disposal, Site selection of nuclear power plants. 9

Hydroelectric station Hydrology, Principles of working, applications, site selection, classification and arrangements, hydro-electric plants, run off size of plant and choice of units, operation and maintenance, hydro systems, interconnected systems.

Text & Reference Books:

1. Power Plant Engineering - F.T. Morse (Affiliated East-West Press Pvt. Ltd)
2. Power Plant Technology – El Vakil (McGraw Hill)
3. Power Plant Engineering - P.K. Nag (Tata McGraw Hill)
4. Steam & Gas Turbines & Power Plant Engineering - R. Yadav (Central Pub House)
5. Steam and Gas turbine – By R. Yadav (Central Publishing House)
6. Gas Turbine – V. Ganeshan (TMH)
7. Thermal Turbomachines – Onkar Singh (Wiley India Pvt. Ltd.)
8. Turbine Compressors and Fans – S.M. Yahya (TMH)
9. Turbines, Compressors and fans - S.M. Yahya (Tata McGraw-Hill)
10. Gas turbine theory - Cohen & Rogers, Addison Weslay (Longman Ltd.)
11. Design of high efficiency turbomachinery and gas turbines - David Gordon (Wilson)

BME-427 **PROJECT MANAGEMENT**

Course category	:	Programme Elective-3 (PE-3)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	To introduce project management theory, terms, and concepts. Students will discover the project life cycle and learn how to build a successful project from pre-implementation to completion.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Knowledge of various phases of project management.
2. Knowledge of structure of different types of organization and its selection.
3. To acquire knowledge about project contracts and its types
4. Know about project appraisal and cost estimation.
5. Ability to apply modern approach to project performance analysis
6. Understand the various aspects of CPM and PERT and their implementation in Project.

Topics Covered

UNIT-I 9

Project Management Concepts: Introduction, project characteristics, taxonomy of projects, project identification and formulation. Establishing the project and goals, Nature & context of project management; phases of PM, A framework for PM issues, PM as a conversion process, project environment & complexity, organizing human resources, organizing systems & procedures for implementation

UNIT-II 9

Project Organization & Project Contracts: Introduction, functional organization, project organization, matrix organization, modified matrix organization, pure project organization, selection of project organization structure, project breakdown structures, project contracts, types of contracts, types of payments to contractors.

UNIT-III 9

Project Appraisal & Cost Estimation: Introduction, technical appraisal, commercial appraisal, economic appraisal, financial appraisal, management appraisal, social cost/benefit analysis, project risk analysis, Cost analysis of the project, components of capital cost of a project, modern approach to project performance analysis.

UNIT-IV 9

Project Planning & Scheduling: Introduction to PERT & CPM, planning and scheduling networks, time estimation, determination of critical path, CPM model, slacks & floats, PERT model, PERT & CPM cost accounting systems, lowest cost schedule, crashing of networks, linear programming formulation of event-oriented networks, updating of networks, LOB technique, Complexity of project scheduling with limited resources.

Text & Reference books:

1. Project Management - K. Nagarajan (New Age International)
2. Operation Research for Executive – L. S. Srinath (EWP)
3. Guide to the Project Management Body of Knowledge - Project Management Institute (Project Management Inst)
4. Project Management - Greer Michael (Jaico Publications)
5. Successful Project Management - Trevor Young (Kogan page)

BME-428 **ADVANCED ENGINEERING MATERIALS**

Course category	:	Programme Elective-3 (PE-3)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	This course provides an in-depth understanding of the key factors that govern the design and selection of materials for use in advanced engineering applications, as well as their processing, properties and stability.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the basic structures, atomic bonding, and importance of materials for different applications.
2. To understand the microstructural phenomenon for different materials
3. To understand the surface behaviour of materials with their phase diagrams.
4. The knowledge of ferrous and nonferrous materials with the inclusion of advanced materials.
5. The knowledge and applications of Mechanical behaviour of different materials.
6. Study the thermomechanical behaviour of materials

Topics Covered

UNIT-I

Introduction 9

Brief history of engineering materials, Importance of materials, Classification of Materials, Engineering Materials, Advanced Materials and Future Materials

Crystallography

Atomic Structure, Atomic Bonding in Solids, Bravais Lattices, Crystal Structures, Crystalline, Quasi Crystalline and Non-Crystalline Materials, Miller Indices, Miller-Bravais Indices for Planes and Directions of Cubic and Non-Cubic Structures.

UNIT-II

Structural Analysis of Materials 9

Microstructural phenomenon for different materials, Diffusion Mechanisms, Fick's Laws, Steady & Non-steady State Diffusion, Scanning Electron Microscope (SEM), Atomic Force Microscope (AFM).

Phase Diagrams

Phase Rule, Equilibrium Phase Diagrams, Phase Systems. Iron-Carbon Phase Diagram, TTT Diagram Imperfections in Solids, Recovery, Recrystallization and Grain Growth, Mechanisms of Strengthening, Solid Solution Strengthening.

UNIT-III

Ferrous &Nonferrous alloys 9

Ferrous Alloys: Low Alloy and High Alloy Steels, Tool Steels, Stainless Steels, Cast irons etc

Non-ferrous alloys: Copper and its alloys, Aluminium and its alloys, Nickel, Zinc, Shape Memory Phenomenon and Alloys; Ceramics, Cermet's, Glass and Carbon Products; Failure Prevention; and The Selection Process.

Advanced Materials

Composite materials, Nano materials, Smart materials, Optical materials etc.

UNIT-IV

Mechanical Behaviour of Materials 9

Study about Stress strain diagram for brittle & Ductile materials (Mild steel), elastic constants, work hardening, Hot and cold working, Fracture, Ductile and Brittle Fracture, Griffith's theory of brittle fracture, Ductile-Brittle Transition, Stress Intensity Factor (SIF), Hardness, Impact Testing, Bending, Fatigue, Creep etc.

Thermo-Mechanical Behaviour of Materials

Thermo-gravimetric analysis (TGA), Dynamic mechanical analysis (DMA), Thermal conductivity etc.

Text & Reference books:

1. A Materials and processing approach - G.E. Dieter (McGraw Hill)
2. Materials selection in Mechanical Design- M.F Ashby (Pergamon press)
3. Engineering Materials Properties and Selection - Kenneth G. Budinski (Prentice Hall of India)
4. Engineering Metallurgy Part 1- R.A. Higgins (Edward Arnold)
5. Selection of Engineering Materials- Gladius Lewis (Prentice-Hall)

BME-429 **HYDRAULIC MACHINES**

Course category : Programme Elective-3 (PE-3)
Pre-requisite Subject : --

Contact hours/week	:	Lecture: 3, Tutorial: 0, Practical: 2
Number of Credits	:	5
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	This subject strengthens the knowledge of theoretical and technological aspects of hydrodynamic forces on jets. It correlates the principles with applications in hydraulic turbines and pumps.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. Define basic principles of operation of different types of Hydraulic Turbines and estimate hydrodynamics thrust of jet on fixed and moving plate.
2. To understand the impact of jets on plates and vanes
3. Comprehend the principles, construction, working and design of Impulse and reaction turbines, and its performance characteristics.
4. Ability to understand the working and design of centrifugal pumps and its performance characteristics.
5. Comprehend the Principles, construction, working of reciprocating and rotary pumps
6. Comprehend the principles, construction and working of various fluid systems

Topics Covered

UNIT-I

Introduction 9

Impulse Momentum Principle, Application of momentum and momentum equation to flow through hydraulic machinery, Euler's fundamental equation, Introduction to hydro electric power plants, major components, surge tanks, etc.

Impact of Free Jets

Force exerted by the jet on stationary flat and curved, hinged plate, moving plate and moving curve vanes, effect of inclination of jet with the surface, jet propulsion of ship

Impulse Turbine

Classification of turbines, Impulse turbines, Pelton wheel, Constructional details, Working, Work done, Power and efficiency calculations, Design aspects, Governing of Impulse Turbines

UNIT-II

Reaction Turbines 9

Francis and Kaplan turbines, Constructional details, Velocity triangles, Power and efficiency calculations, Degree of reaction, Draft tube, Cavitations in turbines, Principles of similarity, Unit and specific speed, Performance characteristics, Selection of water turbines, Governing of reaction turbine

UNIT-III

Centrifugal Pumps 9

Classifications of centrifugal pumps, Construction, Working, Work done by impellor, Heads, Efficiencies of centrifugal pumps, Specific speed, Model testing, Multistage pumps, Pump in series and parallel, Performance characteristics. Net positive Section Head, Cavitations and Separation

UNIT-IV

Reciprocating Pumps: Classification, Components and Working, Single acting and double acting, Discharge, Work done and power required, Coefficient of discharge and slip, Effect of acceleration of Piston, Indicator Diagram, Air Vessels 9

Fluid system: Hydraulic accumulator, Hydraulic intensifier, Hydraulic Press, Hydraulic crane, Hydraulic lift, Hydraulic Ram, Hydraulic coupling, Hydraulic torque converter, Air lift pumps, Jet pumps

EXPERIMENTS

Minimum Eight experiments are to be conducted from the followings:

1. Impact of Jet experiment.
2. Conducting experiments and drawing the characteristics curves of Pelton wheel.
3. Conducting experiments and drawing the characteristics curves of Francis turbine.
4. Conducting experiments and drawing the characteristics curves of Kaplan turbine.
5. Conducting experiments and drawing the characteristics curves of Reciprocating pump.
6. Conducting experiments and drawing the characteristics curves of centrifugal pump.
7. Experiment on Hydraulic Jack/Press
8. Experiment on Hydraulic Brake
9. Experiment on Hydraulic Ram
10. Experiment on Compressor
11. Experiment for measurement of drag and lift on aerofoil in wind tunnel
12. Study through detailed visit of any water pumping station/plant

Text & Reference books:

1. Mechanics of Fluid – Massey B.S. (English Language Book Society, U.K.)
2. Hydraulic Machines - Jagdish Lal (S.K. Kataria & Sons)
3. Introduction to Fluid Mechanics and Fluid Machines – S.K. Som & G. Biswas (TMH)
4. Hydraulics and Fluid Mechanics – Modi P.N, Seth S.M. (Standard Book House)
5. A Treatise on Applied Hydraulics – Addison (Chapman and Hall)

OME-401 MANUFACTURING PROCESSES

Course category	:	Open Electives (OE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial: 1, Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	1. Recognize, understand, and develop working knowledge of broad range of manufacturing processes that are used in the industry. 2. To apply the limitations and advantages of different manufacturing processes with an economic point of view to the industry.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. The students will be able to understand the basic manufacturing processes
2. Comprehend mechanical properties and applications of ferrous, non-ferrous metals and alloys.

3. To acquire knowledge of different forming and casting processes and foundry tools used for the manufacturing of different products.
4. The knowledge of different machine tools and machining processes, welding processes and their applications.
5. The knowledge of sheet metal processes and their applications, powder metallurgy process, basic heat treatment processes,
6. To study various aspects of manufacturing establishments

Topics Covered

UNIT-I **6**

Introduction

Introduction and importance of Manufacturing processes, classification and overview of Manufacturing processes.

Mechanical Properties of Materials

Strength, elasticity, plasticity, stiffness, malleability, ductility, brittleness, malleability, toughness hardness, resilience, hardness, machine ability, formability, weldability, Elementary ideas of fracture fatigue & creep.

Steels and Cast Irons

Carbon steels, their classification based on percentage of carbon as low, mild, medium & high carbon steel, their properties & applications. Wrought iron, Cast iron. Alloy steels: stainless steel, tool steel.

Alloys of Non-Ferrous Metals

Common uses of various non-ferrous metals (Copper, Zink, Tin, Magnesium, Lead, Aluminium etc.) & alloys and its composition such as Cu-alloys: Brass, Bronze, Al-alloys

UNIT-II 6

Forming Processes

Hot-working & cold-working, Basic metal forming operations & uses of such as: Forging, Rolling, Wire & Tube drawing and Extrusion, and their uses.

Presswork: Die & Punch assembly, cutting and forming, its applications.

Casting

Pattern making, Materials, pattern making tools, pattern types and allowances. Type and composition of Molding sands and their desirable properties. Foundry tools, Mould making with the use of a core. Gating system. Casting defects & remedies. Cupola Furnace. Brief description of various types of casting processes.

UNIT-III 6

Machining

Lathe-machine: principle, types, main parts, specifications and operations performed on it., Basic description of machines and operations of Shaper-Planer, Drilling, Milling & Grinding.

Welding

Introduction, classification of welding processes. Gas-welding, types of flames and their applications. Electric-Arc welding. Resistance welding. Soldering & Brazing processes and their uses.

UNIT-IV 6

Sheet Metal Work

Tools and equipments used in sheet metal work, metals used for sheets, standard specification for sheets, Types of sheet metal operations: shearing, drawing, bending

Powder Metallurgy

Introduction of powder metallurgy process: powder production, blending, compaction, Sintering

Heat Treatment Processes

Introduction to Heat- treatment of carbon steels: annealing, normalizing, quenching, tempering and casehardening, Introduction to Galvanizing and Electroplating.

Non-Metallic Materials

Common types & uses of Wood, Cement-concrete, Ceramics, Rubber, Plastics and Composite-materials

Manufacturing Establishment

Plant location. Plant layout–its types. Types of Production. Production versus Productivity.

Text & Reference Books:

1. Workshop Technology Vol-I-B. S. Raghubanshi (DhanpatRai and Sons)
2. Workshop Technology Vol-II-B. S. Raghubanshi (DhanpatRai and Sons)
3. Production Technology - R.K. Jain (Khanna publication
4. Manufacturing Processes- H. N. Gupta, R. C. Gupta, Arun Mital (New Age publisher)
5. Manufacturing Science -Ghosh and Mallik (EWP)
6. Manufacturing processes – Santosh Bhatnagar (B S publication)
7. Production Technology – P. C. Sharma (S. Chand)
8. Manufacturing technology – Machine Tools- P. N. Rao (TMH)
9. Manufacturing technology – Foundry, Forming and Welding- P. N. Rao (TMH).
10. Manufacturing Engineering & Technology- Kalpakjian (Pearson)

OME-402 **ENGINEERING MATERIALS**

Course category	:	Open Electives (OE)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 2, Tutorial: 1, Practical: 0
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, practical work, record, viva voce and Two Minor tests and One Major Theory & Practical Examination
Course Objectives	:	The objective of this course is to provide students a fundamental understanding of mechanical, electrical, and electronic properties of materials and to apply those fundamentals for selecting and developing materials for different engineering applications.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand the importance of numerous materials with their basic concepts including crystallography and imperfections.
2. To understand the advanced materials testing by different mechanical testing methods such as strength testing, hardness, fatigue, NDT, etc.

3. To understand the phase and equilibrium diagram o
4. Different surface behaviour studies of engineering materials including heat treatment processes, TTT diagram and other related processes.
5. To comprehend the magnetic and dielectric property of materials
6. Ability to understand the properties of electronic, smart and nano materials.

Topics Covered

UNIT-I 6

Introduction

Importance of materials, Brief review of modern & atomic concepts in Physics and Chemistry. Atomic models

Crystalline nature of solids

Crystal system unit cell space lattice, Bravais lattices, common crystal structures, Atomic packing factor and density. Miller indices, Imperfections, Defects & Dislocations in solids

UNIT-II 6

Mechanical properties and Testing

Stress strain diagram for Ductile & brittle material, Toughness, Hardness, Fracture, Fatigue and Creep. Testing of materials such as Strength tests, Hardness tests, Impact tests, Fatigue tests, Creep tests, Cold and Hot working of metals and their effect on mechanical properties.

Phase Diagram and Equilibrium Diagram

Unitary and Binary diagrams, Phase rules. Types of equilibrium diagrams: Solid solution type, eutectic type and combination type, Iron-carbon equilibrium diagram.

UNIT-III 6

Ferrous & Non-ferrous material

Various types of carbon steels, alloy steels and cast irons, its properties, uses and applications, Heat Treatment: Various types of heat treatment processes such as Annealing, Normalizing, Quenching, Tempering, and various case hardening processes. Time Temperature Transformation (TTT) diagrams. Diffusion: Diffusion of Solids, Fick's I and II law.

Non-Ferrous metals and alloys

Non-ferrous metals such as Cu, Al, Zn, Cr, Ni etc. and its applications

UNIT-IV 6

Dielectric & Magnetic properties

Dielectric Materials and their applications, Concept of magnetism- Dia, para, ferro magnetic materials, Hysteresis, Soft and hard magnetic materials, Magnetic Storages

Electronic Properties

Energy band, concept of conductor, insulator and semiconductor. Intrinsic and extrinsic semi-conductors, P-n junction and transistors, Basic devices and their applications. Bragg's law, Messier effect. Type I & II superconductors. High Temp. superconductors. Brief description of other material such as optical and thermal materials, Composite Materials and its uses, Smart materials & Nano-materials and their potential applications

Text & Reference books:

1. Material Science and Engineering – Smith, Hashemi and Prakash (Tata McGraw Hill)
2. Material Science- Narula (Tata McGraw Hill)
3. Material Science for Engineering Students- Fischer (Academic Press)

4. Material Science & Engineering - Van Vlash (John Wiley & Sons)
5. Elements of Material Science & Engineering -W.D. Callister (Wiley India Pvt. Ltd.)
6. Technology of Engineering Materials- Philip and Bolton (Butterworth-Heinamann)
7. Material Science -V. Raghvan (Prentice Hall of India)
8. Elements of Material Science & Engineering- Van Vlack (Pearson)

OME -403 **QUALITY MANAGEMENT**

Course category	:	Open Electives (OE)
Pre-requisite Subject	:	--
Contact hours/week	:	Lecture: 2, Tutorial: 1, Practical: 0
	:	
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One MajorTheory Examination.
Course Objectives	:	This subject is related to quality management principles, techniques, tools, and skills for on-the-job applications useful in a wide range of businesses and organizations, including service, manufacturing,
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes after completing this course

1. To understand concepts of quality, total quality management, development ofsources, quality in sales and services, analysis of claims.
2. To acquire knowledge of Organization structure and design, quality function, quality cost,
3. To comprehend the concept of ISO-9000, Taguchi and JIT in industries.
4. The understanding of mathematics of control charts its construction $\bar{X}$
5. The knowledge of Defects diagnosis and prevention, correcting measure,
6. Ability to understand the reliability,maintainability, zero defects and quality circle.

UNIT-I 6

Quality Concepts, Evolution of Quality concept, TQM concept, Quality concept in design. Control of purchased product, evaluation of supplies, capacity verification, development of sources, procurement procedure, Manufacturing Quality Methods and Techniques for manufacture, Inspection and control of product, Quality in sales and services, Guarantee, analysis of claims.

UNIT-II 6

Quality Management Organization structure and design, Quality function deployment, Economics of quality value and contribution, Quality cost, optimizing quality cost. ISO-9000 and its concept ofQuality Management: ISO 9000 series, Taguchi method, JIT

UNIT-III 6

Theory of control charts, measurement range, construction of $\bar{x}$ & R charts, process capability study, and use of control charts. Attribute control charts, Defects, construction and analysis of using p-chart, effect of variable sample size, construction and use of C-chart

UNIT-IV 6

Defects diagnosis and prevention study, corrective measures, factors affecting reliability, MTTF, calculation of reliability, Building reliability in the product, evaluation of reliability, interpretation of test results, reliability control, maintainability, zero defects, quality circle

Text & Reference books:

1. Total Quality Management - Lt. Gen. H. Lal (Wiley Eastern Limited)
2. Introduction to Quality Management and Engineering - Sower, Savoie & Renick (Pearson Education Asia)
3. Beyond Total Quality Management - Greg Bounds (McGraw Hill)
4. TQM in New Product Manufacturing - Menon, H.G (McGraw Hill)

BME-440 PROJECT PART-II

Course category	:	Project (P)
Pre-requisite Subject	:	Project Part-I (BME-370)
Contact hours/week	:	Lecture: 0, Tutorial: 0, Practical: 6
Number of Credits	:	3
Course Assessment methods	:	Continuous assessment through three viva voce/presentation, final project report, contribution made to literary world and Major examination
Course Objectives	:	To develop student's knowledge for solving technical problems through structure project research study in order to produce competent and sound engineers.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Able to design the various component/subsystem of project using basic and advanced knowledge of science and engineering courses.
2. Able to analyze the various components/process of project problem.
3. Able to fabricate the hardware through different fabrication techniques available.
4. Able to make computer programme to design and analyze different components of product.
5. Acquire the ability to write technical report by compiling the
6. Able to make conclusion of given project.

IME-400 Industrial Practices

Course category	:	Industrial Practices (IP)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:0, Tutorial:0, Practical:24
Number of Credits	:	12

Course Assessment methods : The industrial training of the students will be evaluated in three stages: (i) Evaluation by Industry (ii) Evaluation by faculty supervisor on the basis of (iii) Evaluation through seminar presentation/viva-voce at the Institute.

Course Objectives :
1. Participate in the projects in industries during his or her industrial training.
2. Interact with industrial personnel and follow engineering practices and discipline prescribed in industry.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Learn to apply the technical knowledge in real industrial situations.
2. Promote academic, professional and/or personal development
3. Expose students to the engineer's responsibilities and ethics.
4. Familiarize with various materials, processes, products, and their applications along with relevant aspects of quality control. Gain experience in writing technical reports/projects
5. Expose the students to future employers.
6. Understand the social, economic, and administrative considerations that influence the working environment of industrial organizations

BME-480 Minor project

Course category : Minor Project (MP)
Pre-requisite Subject : NIL
Contact hours/week : Lecture:0, Tutorial:0, Practical:8
Number of Credits : 4
Course Assessment methods : Continuous assessment through three viva voce/presentation,preliminary project report, effort and regularity and end semester presentation
Course Objectives :
Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Able to apply engineering knowledge of different streams of mechanical engineering tofinalize the project statement.
2. To carry out literature review of relevant project problem using textbooks, research papersand internet.
3. Able to find out the gap between existing mechanical systems and develop new mechanical system
4. To plan different activities of project to develop a hardware or computer model
5. Apply the theoretical concepts to solve industrial problems with teamwork and multidisciplinary approach
6. Demonstrate professionalism with ethics; present effective communication skills and relate engineering issues to broader societal context

IME-401 Product Design and Manufacturing

Course category	:	Industrial Elective-1 (IE-1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major TheoryExamination
Course Objectives	:	1. Understand modern product development processes. 2. Understand and explain the concept of Industrial design, robust design concepts, rapid prototyping etc.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. To manage the product development process
2. Systematic idea generation to meet the customer needs by incorporating the time-to-market constraint as well.
3. To understand the concepts Design for Manufacturing and Assembly.
4. Ability to apply analytical tools for development, costing and manufacturing
5. To conceptualize, design, and manufacture competitively priced quality products.
6. Prototyping and simulation using modern tools in manufacturing.

UNIT-I 9

Introduction to product design and Manufacturing, Fundamentals of Manufacturing towards Product Development, Engineering Design Process, Product design morphology, Product characteristics

UNIT-II 9

Elements of Visual Design, Translating Customer Needs, Value Engineering, Quality Control, Quality Assurance, Patent, Creativity techniques, Frugal Innovation

UNIT III 9

Rapid Prototyping, an introduction, Rapid Prototyping Modelling, Rapid Prototyping Processes

UNIT IV 9

3D printing, Plant Layout Planning Computer Integrated Manufacturing, Reverse Engineering, Managing Competitiveness

Text & Reference books:

1. Product Design and Manufacturing - A C Chitale and R C Gupta, PH1, - 3rd Edition, 2003.
2. New Product Development - Timjones. Butterworth Heinmann - Oxford. UCI -1997
3. Product Design for Manufacture and Assembly – Geoffery Boothroyd, Peter Dewhurst Winston Knight – 2002
4. Product Design and Development - Karl.T.Ulrich, Steven D Eppinger - Irwin McGrawHill - 2000.

IME-402 **Machinery Fault Diagnosis and Signal Processing**

Course category	:	Industrial Elective-1 (IE-1)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0

Number of Credits : 4

Course Assessment methods : Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major TheoryExamination

Course Objectives : This course will provide students with the state of the art techniques in machinery condition monitoring along with the recent developments in the field of signal processing, thermography, ultrasonics apart from the traditional noise and vibration monitoring.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Basics of Vibration in conditional monitoring.
2. Techniques of data acquisition and analysis.
3. To understand the basics of instrumentation and errors in measurement
4. Ability to find the fault in rotating machines
5. Thermography and its applications in conditional monitoring
6. Ultrasonic monitoring, Oil and wear debris analysis and its properties.

UNIT-I 9

Introduction, Maintenance Principles, FMECA, Fault Diagnostics and Prognostics, Machine Learning in CBM, Basics of Vibration, Free and Forced Response, Vibration and Shock Isolation, Rotor dynamics, Practical Examples of Vibration, Time Domain Analysis, Frequency Domain Analysis, On Stationary Signal Analysis, Modulation and Beats

UNIT-II 9

Orbit and Order Analysis, Computer aided data acquisition, Data Recording, Cepstrum Analysis, Hilbert Transform in Condition Monitoring, Basics of Instrumentation, Signal Conditioning and Filtering, Errors in Measurements, Dynamic Range and Frequency Response, Overview of Transducers for condition-based monitoring

UNIT-III 9

Accelerometers, Vibration Monitoring, Rotational Speed Measurements, Basics of Noise, Noise Monitoring, Introduction to Faults in Rotating Machines, Unbalance Detection, Field Balancing, Misalignment, Crack and Looseness, Journal and Anti-Friction Bearings, Gears, Pumps and Cavitation, IC Engines, machinery Diagnostic Chart

UNIT-IV 9

Thermography, Wear Debris Analysis, Oil Analysis, Ultrasonics, Eddy Current and Acoustic Emission, Radiography, Dye Penetrant Tests, Tool Condition Monitoring, Experimental Modal Analysis, Introduction to Failure Analysis, Railway Locomotive Noise and Vibration Monitoring, Paper Mill Vibration Monitoring, Future of Condition based Monitoring

Books & References

Machinery Condition Monitoring: Principles and Practices, A. R. Mohanty, CRC Press, 2014

IME-403 **Welding Processes**

Course category : Industrial Elective-1 (IE-1)

Pre-requisite Subject : NIL

Contact hours/week : Lecture:3, Tutorial:1, Practical:0

Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major Theory Examination
Course Objectives	:	This course aims to elaborate the physical principles of various welding processes. It covers the fundamentals of heat generation , process principles and overview on types of resistance and solid state welding processes.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Able to demonstrate the physics of welding process
2. Understand the importance and application of welding, conventional welding, formation of arc and arc ignition
3. Develop good knowledge about electric arc welding process and power sources for welding
4. Acquire thorough knowledge about resistance welding and its application
5. Student will have through knowledge about power beam welding processes
6. To acquire understanding of pressure welding process

UNIT-I 9

Introduction, general survey and classification of welding processes, Conventional fusion welding processes, Principal heat sources

Physics of welding arc – Part I General characteristics of an arc, ionisation, dissociation, arc column, anode and cathode fall zones, **Physics of welding arc – Part II** Electrical conductivity of the arc, heat transfer inside the arc and arc ignition.

UNIT-II 9

Introduction to arc welding processes – Part I Principles of gas tungsten arc welding, plasma arc welding, advances in gas tungsten arc welding, Electrical power sources for welding - General characteristics, conventional and electronic power regulator systems – Tapped transformers, Moving-iron control, Variable inductor, Magnetic amplifier, SCR phase control, Transistor series regulator, Secondar switched transistor power supplies, Primary rectifier-inverter, hybrid designs and microprocessor controlled power sources.

Introduction to arc welding processes – Part II Gas metal arc, shielded metal arc, flux cored arc, submerged arc welding -consideration of shielding gases, electrode polarity, current setting, types of metal transfer, process efficiency, melting rate, spatter losses and influence of external magnetic field on arc stability and Advanced GMAW processes. Electrode coverings and their functions, types of fluxes,

UNIT-III 9

Fundamentals of resistance welding – Part I Process principles and overview on types of processes (spot, projection, butt, seam, and flash) Joule effect and temperature distribution.

Fundamentals of resistance welding – Part II Process application range and typical problems (welding thin to thick material, welding of coated/ painted materials, welding dissimilar materials, mass effect, shunt effect, Peltier effect, resistance brazing.

UNIT-IV 9

Introduction to power beam welding processes, Plasma, laser, and electron beam welding processes - principles and modes of operation, applications, and advantages

Principles of power beam welding processes Keyhole formation, power densities, forces acting in keyhole, pressure balance for a generalised keyhole, heat transfer in laser and electron beam welding processes.

Introduction to pressure welding processes - solid state bonding, friction welding, friction stir welding, ultrasonic welding, explosive welding, diffusion bonding and adhesive bonding. Principles and operational considerations of pressure welding processes

Text and Reference books:

1. Advanced welding processes by John Norrish, ISBN: 978-1-84569-130-1.
2. Principles of Welding by Robert W. Messler Jr., ISBN: 978-0-471-25376-13.
3. Welding Technology by G. den Ouden and M. Hermans, ISBN: 978-90-6562-205-1.
4. The Physics of Welding, J.F. Lancaster, ISBN: 0-08-034076

IME-404	**Oil Hydraulics and Pneumatics**
Course category	: Industrial Elective-1 (IE-1)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture:3, Tutorial:1, Practical:0
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major Theory Examination
Course Objectives	: This course provides a comprehensive introduction to fluid power, including both oil hydraulics and pneumatics. The course will introduce the basic theoretical principles, design techniques, analysis tools for industry prevalent hydraulics and pneumatics systems.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Ability to explain the basic laws of hydrostatic and hydrodynamic
2. Comprehend the properties of hydraulic components and circuits
3. Comprehend the basic principles of pneumatics, and change correlations of air with temperature, pressure, volume
4. Ability to recognize and comprehend the components used in the pneumatic power circuits
5. Understand the operation of basic circuits
6. Ability to read basic circuits, troubleshoots, and analyze

UNIT-I 9

Introduction: Merits and Demerits of Fluid Power, Power Transmission Method, Brief History, Application Areas, Major Divisions of Fluid Power System, Introduction to Oil Hydraulics and its Basic Components, Introduction to Pneumatic and its Basic Components, Applications-Stationary and Mobile, Typical Application of Fluid Power System, Status and Development, Pascal's law and its application, Pressure Intensifier, Air-to-Hydraulic Booster and Bernoulli equation, Applications of Bernoulli equation-Venturi, Torricelli's theorem, Siphon, Continuity equation and flow configuration, Concept of pressures and Gas laws

Introduction to Fluid Power Symbols, Hydraulic lines and Colour Coding, Symbols for Functional Units, Hydraulic Pumps, Hydraulic Motors, Cylinders, Air Compressors, Pneumatic Motors and Orifices, Symbols for Filters, Check Valves, DCVs, Spool Actuation methods, PCV, Miscellaneous, Port Configurations.

UNIT II 9

Introduction to Hydraulic Pumps: Facts and Figures, Classifications, Positive Displacement pump and pumping theory, Ideal pump, pump losses, efficiency curve, Constructional features and Operations of External Gear pump, Construction features and operations of Internal Gear Pump, Gerotor Pump and Screw Pump, Vane Pump, Pumping theory, Construction and Operation of Unbalanced Vane Pump, Vane loading and solutions, Different Vanes, Variable Displacement Pressure Compensated Vane Pump, Balance Vane Pump, Kinematic Inversion of Vane pump, Piston pump, Pumping theory, Constructional features and Operations of Hand Pump-Single acting, Twin single acting, Double acting, Two-stage Axial Piston Pump- Construction and Operating principles of Bent axis and Swash plate type pump, Radial Piston Pumps- Construction and Operation, Pump failure and Cavitations, Important parameters while selecting Pump.

UNIT III 9

Pneumatic Control System-Introduction, Air Preparation-Primary and Secondary Air Treatment, Pneumatic Power Source- Compressor, Classification, Air Receiver and Control Methods, Reciprocating Type Air Compressor-Single and Multi-stage Piston Pump, PV Diagram and Work Done, Construction and Operation of Two-stage Reciprocating type Air Compressor, Diaphragm Type Air Compressor, Rotary Vane Compressor, Twin Lobe Air compressor, Screw Compressor, Liquid Ring Compressor and Selection Criteria, Energy Loss and Cost Break Down in Air Preparation Process, Pressure Drop and its Effect, Minimising Pressure Drop,

Air Distribution System- Sizing of Pipes, Tubes, Materials and Fittings, Important Air Flow Parameters, Pressure drop Predictions using Various Empirical Formulae and Nomogram, Best Practices for Compressed Air Piping System and Installation Tips, Need for Air Dryer, Analysis of Moisture Removal from Air, Typical Air Drying Methods, Basic Types of Air Dryers, Construction and Operation of Refrigerated Air dyers, Absorption Dryer, Adsorption Dryer, Membrane Dryer, Selection of Air Dryer, Directional Control Valves, Pressure Control Valves, Flow Control Valves, Estimation of leakage through spool and housing bore and Estimation of leakage through spool and housing bore

UNIT IV 9

Hydraulic Motors: Hydraulic Cylinder, Fluid Power Actuators, Hydraulic Reservoir,

Coolers and Filters, Hydraulic Fluids, Conduits, Hydraulic accumulators, Classifications, Applications, Accumulator physics, Maintenance, Hydraulic accumulators, Classifications, Applications, Accumulator physics, Maintenance, Oil Hydraulic Circuits: Design and Analysis,

Pneumatic Circuits: Design and Analysis, Pneumatic Circuits: Design and Analysis of Multiple Actuator, Pump-controlled Hydraulic Systems, Hydrostatic Transmissions, Proportional Valve Technology, Electrohydraulic Servo Valve (EHSV), Electro-Hydraulic Actuator (EHA), Modelling and Simulation in Hydraulic Components

Textbooks and Reference Books:

1. Anthony Esposito. Fluid Power with Application, Pearson Education, inc, 2000.
2. John J Pippinger and Tyler Gregory Hicks. Industrial Hydraulics, McGraw-Hill, 1979.
3. Dudley A. Pease and John J. Pippenger. Basic Fluid Power. Prentice-Hall 1987.
4. John S. Cundiff. Fluid Power Circuits and Controls: Fundamentals and Applications, CRC Press,2001.
5. Noah D. Manring and Roger C. Fales. Hydraulic
6. Herbert E. Merritt. Hydraulic Control Systems. John Wiley & Sons, Inc.USA, 1967.
7. Allen C. Morse. Electrohydraulic Servo mechanisms. McGraw-Hill, 1963.
8. John Watton. Fluid Power Systems. Prentice-Hall International (UK) Ltd.,1989.

IME-405	**Non - Metallic Materials**
Course category	: Industrial Elective-2 (IE-2)
Pre-requisite Subject	: NIL
Contact hours/week	: Lecture:3, Tutorial:1, Practical:0
Number of Credits	: 4
Course Assessment methods	: Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major Theory Examination
Course Objectives	: The course aims students to understand the structure - property relationship in a wide spectrum of non – metallic materials. The subject aims to provide expertise on structure / properties / processing / performance of non-metallic materials emphasizing the technological aspects that should govern its application in engineering components.
Course Outcomes	: The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. To acquire understanding of various defects in non-metallic and crystalline materials
2. To demonstrate the knowledge of mechanical, magnetic, and thermal properties of non-metals and composite
3. Optical and Electrochemical properties of non - metallic materials
4. To acquire the understanding the various processing technique of non-metallic materials
5. To comprehend the understanding of various thin film growth techniques and organic electronic materials
6. Ability to Measure the mechanical, electrical, thermal, magnetic, and optical properties of non-metallic materials

UNIT-I 9

Classification of non-metallic materials. Applications of ceramics, glass, carbonaceous materials, polymers, and composites. Understanding on polymer structures, Characteristics and applications of polymers, Processing of polymers. Polymer composites and issues related to recycling, Defects, and reaction kinetics of non-metallic materials, carbonaceous materials, **Defects in crystalline materials:** Point, line, planar and three dimensional defects, Non- stoichiometry in non-metallic materials, Laws of thermodynamics, reaction kinetics, Phase diagram and microstructure evolution of selected non-metallic materials, Carbonaceous materials, Diffusion, phase transformation in non-metallic materials, glass and glass-ceramics, Fundamentals of diffusion, Fick's laws, their solution and applications, Phase transformation of non-metallic materials, Introduction to glass and amorphous solids Specialty glasses, Glass ceramics.

UNIT-II 9

Mechanical properties of non-metallic and composite materials: Mechanical properties of non-metallic materials, stress-strain response, elastic, anelastic and plastic deformation Brittle and ductile materials, fracture mechanics, strengthening of materials Fatigue, creep and nano-scale properties.

Composite materials: Particle-reinforced composites, and fiber reinforced composites, Structural composite, electrical, magnetic and thermal properties of non-metallic materials, Dielectric and piezoelectric behaviour, Ferroelectric behaviour of non-metallic materials and ferroelectric thin film for non-volatile memory applications.

Magnetic properties: Origin of magnetism, para, ferro and ferrimagnetism, Ceramic magnets, and their applications,

Thermal properties: Specific heat, heat conduction, thermal diffusivity, thermal expansion, thermoelectricity.

Optical and Electrochemical properties of non - metallic materials: Optical properties: Refractive index, Absorption and transmission of electromagnetic radiation, LASERS, **Introduction to electrochemistry:** Galvanic cells, Cell potentials and Gibbs energy, Concentration dependence, Introduction to electrochemical methods: cyclic voltammetry, electrochemical impedance spectroscopy, Electrochemical storage, rechargeable batteries, Fuel cell and Energy harvesting

UNIT-III 9

Processing of non-metallic materials, Sintering and microstructure development Preparation of ceramic powders: auto-combustion, sol-gel synthesis, microwave assisted hydrothermal synthesis. Introduction to sintering, sintering mechanism, Solid state sintering and microstructure development. Liquid phase sintering and microstructure development, specialty sintering, and reactive sintering, Processing of glass and amorphous/non-crystalline solids.

Thin film growth and fabrication of devices: Fundamental of thin film growth, growth mechanism and kinetics, Various thin film growth techniques: thermal evaporation, CVD, sputtering, chemical solution deposition.

Organic electronic materials: conducting polymers, semi-conducting organic materials, applications. Characterization of structure, composition, and microstructure of non – metallic material. Introduction to spectroscopic techniques for material characterization Thermal analyses, Infra-red and Raman spectroscopy, VIS and X-ray photoelectron spectroscopy, Optical and scanning electron microscopy

UNIT-IV 9

Measurement of the mechanical, electrical, thermal, magnetic, and optical properties of non - metallic materials: Measurement of mechanical properties, fracture toughness, MOR, hardness, Measurement of electrical properties: Electrical conductivity, carrier mobility, carrier concentration, hysteresis, fatigue, time dependent dielectric breakdown.

Thermal analysis techniques: Thermo-gravimetry, calorimetry. Measurement of magnetic properties Measurement of optical properties, Corrosion and degradation of non-metallic materials, Fundamentals of corrosion, corrosion of ceramic materials.

Degradation of polymers: swelling and dissolution, bond rupture, weathering Case study: Artificial total hip replacement.

Economic, Environmental and societal issues in non - metallic materials science and engineering: An Introduction- Component design, Materials and manufacturing techniques, Recycling issues in non-metallic materials Science, Fly-ash based glazed wall tiles: A case study.

Text and Reference books:

1. Materials Science and Engineering: An Introduction, William D. Callister. Jr
2. Essentials of Materials Science and Engineering, Donald R. Askeland and Pradeep P. Phule.
3. Understanding Solids: The Science of Materials, Richard. J.D. Tilley
4. Michael W. Barsoum, Fundamentals of Ceramics, 2nd Edition, CRC Press
5. C. Barry Carter, M. Grant Norton, Ceramic Materials Science and Engineering, Springer
6. David W. Richerson, Modern Ceramic Engineering, Properties, Processing, and Use in Design, 3rd Edition, Taylor and Francis.

IME-406	**Mechanical Behaviour of Materials**	
Course category	:	Industrial Elective-2 (IE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major Theory Examination

Course Objectives : The course is intended to develop a working knowledge in deformation and fracture of materials and its relation to material microstructure.

Course Outcomes : The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Students will demonstrate an understanding of the mechanical properties and behaviour of materials.
2. Students will demonstrate the knowledge of how these properties are measured.
3. Students will demonstrate the ability to determine states of stress in three dimensions
4. Students will demonstrate the ability to apply constitutive laws to solve deformable body problems.
5. Students will demonstrate the ability to identify engineering problems involving plastic deformation, fatigue, and fracture, and the tools required to solve these problems.
6. Students will demonstrate recognition of failure mechanisms and identify key mechanical properties

UNIT-I 9

Elastic constants (atomistic origin), State of stress in 2D/3D, Transformation of stress, Principal stresses, Mohr Circle, Stress-strain relationships in isotropic and anisotropic materials, Viscoelasticity, Tensile test

UNIT-II 9

Tests for Plasticity (Compression, Torsion, Bend testing, Hardness and measurement, Yield criteria, Effective Stress and Effective Strain, Theoretical Strength, Concept of Dislocations, Concept of Slip, Burger Vector and its properties, Stress and Strain fields of Dislocations

UNIT-III 9

Energy of Dislocations, Forces on dislocation, Line tension, Motion of Dislocations, Peierls Model, Concept of slip systems, Single crystal slip (critical resolved shear stress - CRSS), Dislocations in FCC and partial dislocations, Stacking faults and energy, Dislocation in other crystal systems, Source of dislocations and multiplication

UNIT-IV 9

Strengthening mechanisms (Strain hardening, Solid Solution Strengthening), Strengthening mechanisms (Precipitation and Dispersion Strengthening), Strengthening Mechanism (Grain Boundary and Hall-Petch relation, Martensitic Strengthening)

Text and reference Books:

1. Mechanical Behaviour of Materials, M. A. Meyers and K. K. Chawla
2. Mechanical Metallurgy, G.W. Dieter
3. Mechanical Behavior of Materials, William F. Hosford
4. Introduction to Dislocations, D. Hull and D.J. Bacon
5. Deformation Behaviour and Fracture Mechanics of Engineering Materials, R. W. Hertzberg
6. Mechanical Behaviour of Materials, Courtney

IME-407 **Gas Dynamics and Propulsion**

Course category : Industrial Elective-2 (IE-2)

Pre-requisite Subject : NIL

Contact hours/week	:	Lecture:3, Tutorial:1, Practical:0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes, two minor tests and one Major Theory Examination
Course Objectives	:	The subject aims to provide the basic concept and importance of gas dynamics so that students can interpret the flow pattern in flow and nonflow systems. The course focuses on the nature of aircraft engines, the various components in the engine, how these engines operate.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Student will understand the concept of gas dynamics, fundamental equations, and isentropic flow.
2. Ability to get the knowledge of compressible flows and pertaining calculations.
3. Apply the thermodynamics concepts in relation to compressible flows and derive relationships between various compressible flow parameters
4. Student will be able to demonstrate the wave phenomena and make calculations for variable flow area like nozzle design pressure and efficiency.
5. Able to understand and demonstrate the basics of jet propulsion, various jet propulsion engines and their efficiency calculations.
6. Analyse the performance of aircraft and rocket propulsion engines

UNIT-I 9

Concept of Gas Dynamics

Introduction, Applications

Fundamental Equations of Steady Flow

Introduction, Assumption, Equation of Continuity, Control Volume, Momentum Equation, Bernoulli‘s Equation, Steady Flow Energy Equation.

Isentropic Flow

Introduction, Acoustic Velocity, Flow from a Reservoir, Flow Parameters

UNIT-II 9

Diabetic Flow

Introduction, Stagnation Temperature, Rayleigh Line, Pressure Ratio, Temperature Ratio.

Flow with Frication and No Heat Transfer Adiabatic Flow

Introduction, Frication Loss, The Fanning Equation, Frication Factor, Fannoline.

UNIT-III 9

Wave Phenomena

Introduction, Normal Shock Waves, Oblique Shocks.

Variable Area Flow

Introduction, Velocity, Criteria for Acceleration and Deceleration, Effect of Back Pressure onNozzle Flow, Over-expanding and Under-expanding Nozzles, Design Pressure, Nozzle Efficiency.

UNIT-IV 9

Jet Propulsion

Introduction, Types, Pulse jet, Ram jet, Turbojet, Efficiency and Horsepower of Propulsion, Flying Unit.

Books & References

1. The Dynamics and Thermodynamics of Compressible Fluid Flow, Vol. I – Shapiro
2. Gas Dynamics - Cambel and Jennings (McGraw Hill)
3. Elements of Gas Dynamics – Mattingly (Tata McGraw-Hill Education)
4. Fundamental of gas dynamics – Zucker, and Biblarz (John Wiley & Sons, Inc)
5. Dynamics of compressible flow- Yahya (New Age Publishers, Delhi)

IME- 408 PRODUCTION PLANNING & CONTROL

Course category	:	Industrial Elective-2 (IE-2)
Pre-requisite Subject	:	NIL
Contact hours/week	:	Lecture: 3, Tutorial: 1, Practical: 0
Number of Credits	:	4
Course Assessment methods	:	Continuous assessment through tutorials, attendance, home assignments, quizzes and Two Minor tests and One Major Theory Examination
Course Objectives	:	The objective of this course is to impart important decision-making processes and analytical tools in design, planning and control of manufacturing / service processes. It will help students to establish routes and schedules for work that will ensure the optimum utilization of resources in a manufacturing / service.
Course Outcomes	:	The students are expected to be able to demonstrate the following knowledge, skills, and attitudes after completing this course

1. Know about the characteristics of production systems, objective, and functions of Production role of production planning in manufacturing organization,
2. To understand the concept of Forecasting and Market Analysis.
3. The understanding of Aggregate Planning, Routing, scheduling and dispatching, Sheets & charts, Line Balancing.
4. Understand the concept of progress control through records and charts, inventory control, Economic lot (batch) size, Trends in purchasing and store keeping, and JIT production.
5. Ability to apply the concept of productivity, productivity patterns, measurements & ratios,
6. Acquire the concept of human abilities, training & motivation, safety programs, workplace design.

Topics Covered

UNIT-I

Introduction 9

Types and characteristics of production systems. Objective and functions of Production, Planning & Control, Role of production planning in manufacturing organization.

Preplanning

Forecasting: characteristics of demand over time, forecasting qualitative model: Delphi, naïve quantitative models: simple average, simple moving average, weighted moving average, exponential smoothing, selection of forecasting models, Market Analysis. Plant Layout, Equipment policy and replacement. Capacity planning.

UNIT-II

Production Planning 9

Aggregate Planning: Concept, strategies for aggregate planning: three pure planning strategies, graphical method for aggregate output planning, master production scheduling (MPS), and procedure for developing MPS. Routing, Scheduling and dispatching. scheduling techniques for job shop, stages in scheduling, load charts and machine loading charts, dynamic sequencing rules, scheduling product- focused systems, scheduling for flexible manufacturing system. Sheets & charts, Line Balancing.

UNIT-III

Production and Inventory Control 9

Progress control through records and charts, Types of inventories, Inventory Classification. Inventory Control under constraints, Economic lot (batch) size. Trends in purchasing and store keeping, JIT production, MRP & MRP II, comparison of Push & Pull systems, ERP, CAPPC.

UNIT-IV

Productivity 9

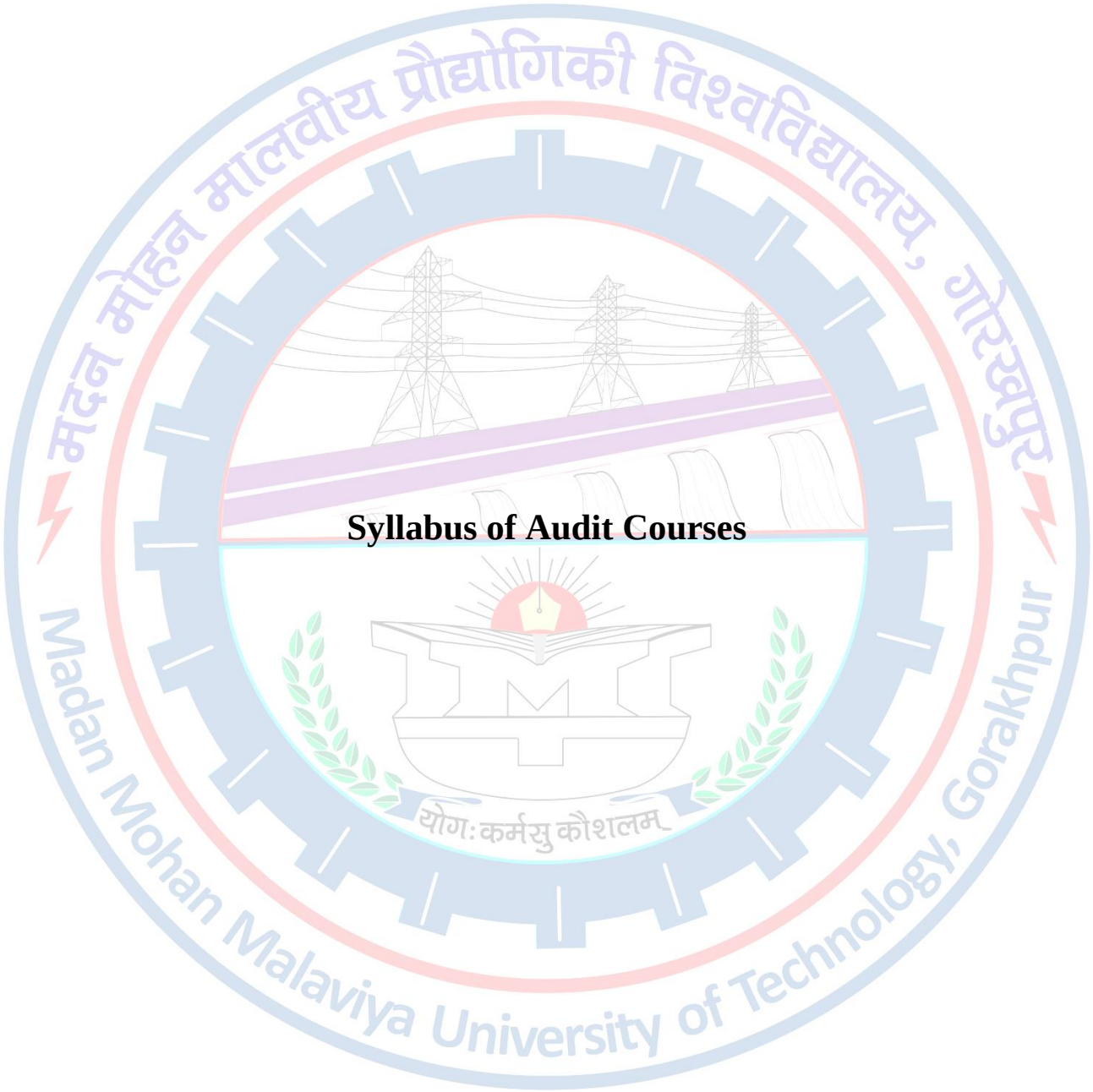
Importance, Productivity patterns, productivity measurements & ratios, improvement majors.

Human Factors & Ergonomics

Human abilities, training & motivation, safety programs, workplace design.

Text & Reference books:

1. Elements of Production Planning & Control –Eilon (Universal Publishing Corporation)
2. Production Planning Control and Industrial Management – Jain and Agrarwal (Khanna Publishers)
3. Modern Production Operations Management – Buffa (John Wiley & Sons Inc)
4. Manufacturing Planning and Control Systems - Vollmann Thomas E, Bery William L (McGraw-Hill)
5. Production Systems – J.L. Riggs (John Wiley and Sons)



Syllabus of Audit Courses

CONSTITUTION OF INDIA

Course Code: : **AUC 01** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

COURSE OUTCOME:

At the end of the course, learners should be able to

CO1- Student will Identify and explore the basic features and modalities about Indian constitution

CO2- Students will be able to differentiate and relate the functioning of Indian parliamentary system at the center and state level.

CO3- Student will be able to differentiate different aspects of Indian Legal System and its related bodies.

UNIT 1--Introduction and Basic Information about Indian Constitution: Historical Background of the Constituent Assembly, The Preamble of the Constitution, Fundamental Rights, Fundamental Duties, Directive Principles of State Policy, Parliamentary System, Federal System.

UNIT 2-Union Executive and State Executive: Powers of Indian Parliament Functions of Rajya Sabha, Functions of Lok Sabha, Powers and Functions of the President, Powers and Functions of the Prime Minister, Judiciary.

UNIT 3- Introduction and Basic Information about Legal System: The Court System in India and Foreign Courtiers (District Court, District Consumer Forum, Tribunals, High Courts, Supreme Court).

UNIT 4- Intellectual Property Laws and Regulation to Information: Introduction, Legal Aspects of Patents, Filing of Patent Applications, Rights from Patents, Infringement of Patents, Copyright, Information Technology Act, 2000. The Company's Act:

Reference:

1) G. Austin (2004) Working of a Democratic Constitution of India, New Delhi: Oxford University Press.
2) Basu, D.D (2005), An Introduction to the Constitution of India, New Delhi, Prentice Hall.
3) N. Chandhoke & Priyadarshini (eds) (2009) Contemporary India: Economy, Society, Politics, New Delhi: Oxford University Press.
4) N.G Jayal and P.B. Maheta, (eds) (2010) Oxford Companion to Indian Politics, New Delhi: Oxford University Press.

Indian Culture and Heritage

Course Code: : **AUC 02** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Unit-I
Indian Culture: An Introduction, Characteristics of Indian culture, Significance of Geography on Indian Culture, Society in India, Religion and Philosophy in India.

Unit-II
Indian Languages and Literature, Evolution of script and languages in India, Harappan Script and Brahmi Script, History of Buddhist and Jain Literature.

Unit-III
A Brief History of Indian Arts and Architecture, Indian Art & Architecture: Gandhara School and Mathura School of Art; Hindu Temple Architecture, Buddhist Architecture, Medieval Architecture and Colonial Architecture. Indian Painting Tradition: ancient, medieval, modern Performing Arts: Divisions of Indian classical music: Hindustani and Carnatic, Dances of India: Various Dance forms: Classical and Regional, Rise of modern theatre and Indian cinema.

Unit-IV
Spread of Indian Culture Abroad, Causes Significance and Modes of Cultural Exchange - Through Traders, Teachers, Emissaries, Missionaries and Gypsies, Indian Culture in South East Asia, India, Central Asia and Western World.

Recommended Readings:

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

Indian Architecture

Course Code: : **AUC 03** **Credits (0-0-0)**
Course Category : **Audit**

Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course outcome
CO1- This course will help student learn about the development of Indian architecture and its contextual and traditional aspects.
CO2- The learner will gain knowledge of the development of architectural forms with reference to technology, style and character in various aspects of Hindu architecture.
CO3- The students will comprehend and relate to the theoretical basis of Budhdhist and Jain Architectures.

UNIT 1; Indus Valley Civilization: Town planning principles, cultural ethos, economy exemplified. The Aryan civilization: With its emphasis on the Vedic town plan.
UNIT 2: Buddhist Architecture Typology of lats, eddicts, stupas, viharas, and chaityas, both in rock-cut or other wise. The Buddhist philosophy and its imprint

UNIT3; Hindu Architecture, Indo Aryan: The evolution of the temple form, evolution of the shikhara in north India. The three schools of architecture - the Gujarat, the Khajuraho, and the Orrisan styles, Introduction to Dravidian Hindu Architecture.

UNIT 4: Jain Architecture : The temple cities of Palitana, Mount Abu and Girnar. Jain Theory The Jain philosophy and its imprint in built form.

REFERNCE BOOKS

1. Stella Kramrisch, The Hindu temple, Volume 1 & 2, Motilal Banarsidass Publications, 1996.
2. Percy Brown, Indian Architecture (Buddhist and Hindu period), D.B.Taraporewala Sons & co Pvt. Ltd. 1965
3. Volwahsen, Andreas, Living Architecture
4. Satish Grover, The Architecture of India- Volume 2, Vikas, 1980.
5. Henri Stierlin, Anne Stierlin, Hindu India: from Khajuraho to the temple city of Madurai, Taschen, 1998.
6. James Fergusson, History of Indian & Eastern Architecture, 2007
7. C. Batley, Design Development of Indian Architecture, John murray, London, 1934.

Indian Festivals

Course Code: : **AUC 04** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : ½ Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

CO1-Students will learn about rich cultural aspects associated with Indian religions

CO2-The course will give deep insight in to understand the importance of festivals.

UNIT 1; Indian Festivals: Introduction to major Indian festivals Bihu, Raksha Bandhan , Onam, Pongal, Holi, Dipawali, Dushehra, Easter, Good Friday, Christmas , Eid-ul-fitr and Eid-ul-Azha , Cultural aspects of festivals .

UNIT 2 ; **Characteristics of Indian festivals** ; Seasonal in nature, seasonal festival are Agro based, worships of animals.

UNIT 3; festivals observed at same time but with different names in different parts of country.

UNIT3 : Artificial or non religious festivals- like Jaisalmer desert festivals, Mango festivals in Delhi, Elephant festivals in India. Etc.

REFERENCE BOOKS

1) Discover India; Festival of India by Sonia Mehta

2) Hindu Festival : Origin, sentiments and Rituals by Mukuncharan Das.

VAIDIC MATHEMEATICS

Course Code: : **AUC 05** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course outcomes:

● Vedic mathematics methods are used in coding and VLSI implementation of encryption.
● Vedic mathematics method of division, exponentiation and multiplication are used in internet security and cryptographic algorithms for making these calculations faster than before.
● Arithmetic and logic unit (ALU) is responsible for all mathematical and logical calculations in computers. Some sutras like udharvtriyakbhyam and nikhilam are used for implementing multiplication methods.
● Digital Signal Processing (DSP) includes face recognition, text speech conversion, image processing and audio -video processing and also filtering of noise. In this area VM methods are very useful to improve the performance of DSP algorithms.

UNIT-I

Introduction & history of Vedic mathematics, Arithmetic and number, Vedic Maths Formulae, Addition and Subtraction: Addition - Completing the whole , Addition from left to right , Addition of list of numbers - Shudh method , Subtraction - Base method , Subtraction - Completing the whole, Subtraction from left to right

UNIT-II

Multiplication: Ekadhikenpurven method (multiplication of two numbers of two digits), Eknunenpurven method (multiplication of two numbers of three digits), Urdhvatiragbhyam method (multiplication of two numbers of three digits), Nikhilam Navtashchramam Dashtaha (multiplication of two numbers of three digits), Combined Operations

Division and Divisibility: Division, Nikhilam Navtashchramam Dashtaha (two digits divisor), Paravartya Yojyet method (three digits divisor)

Divisibility: Ekadhikenpurven method (two digits divisor), Eknunenpurven method (two digits divisor)

UNIT-III

Least Common Multiple **(LCM)** and Highest Common Factor **(HCF)**

Power and Root Power: Square (two digit numbers), Cube (two digit numbers).

Root: Square root (four digit number), Cube root (six digit numbers)

UNIT-IV

Contribution of Indian Mathematicians (In light of Arithmetic) , Aryabhatt , Brahmagupt , Mahaveeracharya , Bharti Krishna Tirtha

Reference Books:

1. Vedic Mathematics, Motilal Banarsi Das, New Delhi.

2. Vedic Ganita: Vihangama Drishti-1, Siksha Sanskriti Uthana Nyasa, New Delhi.

3. Vedic Ganita Praneta, Siksha Sanskriti Uthana Nyasa, New Delhi.

4. Vedic Mathematics: Past, Present and Future, Siksha Sanskriti Uthana Nyasa, New Delhi.

5. Leelavati, Chokhambba Vidya Bhavan, Varanasi.

6. Bharatiya Mathematicians, Sharda Sanskrit Sansthan, Varanasi.

ASTRONOMY

Course Code: : **AUC 06** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

UNIT-I

Historical introduction: Old Indian and western – astronomy – Aryabhatta, Tycho Brahe, Copernicus, Galileo – Olbers paradox – solar system – satellites, planets, comets, meteorites, asteroids.
Practical astronomy – telescopes and observations & techniques – constellations, celestial coordinates, ephemeris.
Celestial mechanics – Kepler's laws – and derivations from Newton's laws.
Sun: Structure and various layers, sunspots, flares, faculae, granules, limb darkening, solar wind and climate.

UNIT-II

Stellar astronomy: H-R diagram, color-magnitude diagram – main sequence – stellar evolution – red giants, white dwarfs, neutron stars, black holes – accretion disc – Schwartzchild radius – stellar masses Saha–Boltzman equation – derivation and interpretation.

Variable stars: Cepheid, RR Lyrae and Mira type variables – Novae and Super novae. Binary and multiple star system – measurement of relative masses and velocities. Interstellar clouds – Nebulae.

UNIT-III

Transformations Generalized Coordinates, Canonical transformations, Conditions for canonical transformation and problem, Poisson brackets, invariance of PB under canonical transformation, Rotating frames of reference, inertial forces in rotating frames.

UNIT-IV

Relativity and Application Concept of Special Theory of Relativity, Lorentz Transformation, Length Contraction and time dilation, Relativistic addition of velocities, conservation of mass and momentum, Concept of General Theory of Relativity, Equivalence of mass and energy, Relativistic Doppler shift and aberration of light. Lagrangian and Hamiltonian of relativistic particles, Relativistic degenerate electron gas.

Reference Books:

- "Textbook of Astronomy and Astrophysics with elements of Cosmology", V. B. Bhatia, Narosa publishing 2001.
- William Marshall Smart, Robin Michael Green "On Spherical Astronomy", (Editor) Carroll, Bradley W Cambridge University Press ,1977
- Bradley W.Carroll and Dale A. Ostlie. "Introduction to modern Astrophysics" Addison-Wesley, 1996.
- Bradley W.Carroll and Dale A. Ostlie, "An Introduction to Modern Astrophysics" Addison Wesley Publishing Company,1996
- 'Stellar Astronomy' by K. D Abhayankar.
- 'Solar Physics' by K. D Abhayankar.

ARTS OF INDIA

Course Code: : **AUC 07** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

CO1- Students will be introduced to emergence and development of art traditions upto 6th century C.E. Monuments will be studied in their cultural context.

CO2-Students will able to understand the monuments in their religious, regional and stylistic context. Students will be able to prepare plans of the monuments.

Unit 1:

Introduction to traditions of Art and Architecture in India . Introduction to Art and Architecture and prelude to historical art. ii. Art of the pre-Mauryan period. iii. Art and Architecture of Mauryan Period iv. Sources of Inspiration of Mauryan Art and Architecture: Foreign and Indigenous.

Unit 2:

Emergence and Development of Structural Stupa Architecture . Origin of Stupa Architecture. ii. Stupa Architecture - Pre-Mauryan and Mauryan periods. iii. North India, Central India, Deccan and Gandhara iv. Structural monasteries and Chaityas.

Emergence and Development of Rock-cut Architecture. Origin of Rock-cut Architecture. ii. Eastern India, Western Deccan, Eastern Deccan, Central India.

Unit 3:

Unit 4: Emergence and Development of Temple Architecture (08 hrs) i. Origin of Temple Architecture- Theoretical aspects. ii. Concept and symbolism of Temple. iii. Archaeological remains of structural temples. iv. Temple Architecture during the Gupta period. v. Temple Architecture during the Vakataka period.

Unit 4:

Sculptural Art and Paintings - Emergence and Development (10 hrs) i. Sculptural Art and Paintings -Concept and Symbolism. ii. Terracottas, Ivories and Bronzes iii. Paintings iv. Stone sculptures-Gandhara, Mathura, Sarnath and Andhra schools of Art. v. Art during the Gupta-Vakataka period.

Recommended Readings:

1. Barua, B. 1934-37. Barhut Vol. I-III. Calcutta: Indian Research Institute.
2. Cunningham, Alexander 1966. The Bhilsa Topes. Varanasi: Indological Book Corporation.
3. Cunningham, Alexander 1965. The Stupa of Bharhut. Varanasi: Indological Book Corporation.
4. Dallapiccola, L.S.Z. Lallemant. 1980. The Stupa : Its Religious, Historical, and Architectural Significance. Wiesbaden: Franz Steiner Verlag.
5. Dehejia, Vidya 1972. Early Buddhist Rock Temples A Chronological Study. London: Thames and Hudson

INTELLECTUAL PROPERTY RIGHTS

Course Code:	**:**	**AUC 08**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

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

CO1: Create an understanding on Intellectual Properties and the importance of it.

CO2: Understand Trademarks and Trade secrets. To create awareness of unfair completion and methods of it.

CO3: Create awareness on the protection copyrights and patents. Understand the Ownership rights and transfer.

CO4: Create awareness of Cyber laws, Cyber Crime and get understanding of Privacy of Data.

CO5: To create awareness international aspects of IPR and the Emerging Trends in IPR.

Course Content

UNIT – I: Introduction to Intellectual property: Introduction, types of intellectual property—Patent, Trademarks, Copy rights, IPR and World Trade Organization, other international organizations,

agencies and treaties, importance of intellectual property rights. Creating Intellectual Property. Intellectual Property Management. Emerging Issues in IPR. Research and Development in India.

UNIT – II: Fundamentals of Patent: Historical Overview of Patent Law; Concept of Patent; Patentable Inventions; Procedure for Obtaining Patent; Rights and Obligations of Patent Holder; Transfer and Infringement of Patent Rights, Geographical Indications, Case Study: Apple versus Samsung Patent Dispute.

UNIT – III: Trademarks: Purpose and function of trademarks, acquisition of trademark rights, protectable matter, selecting, and evaluating trademark, trade mark registration processes.

UNIT – IV: Copy rights: Fundamental of copy right law, originality of material, rights of reproduction, rights to perform the work publicly, copy right ownership issues, copy right registration, notice of copy right, international copy right law. Law of patents: Foundation of patent law, patent searching process, ownership rights and transfer.

Textbooks

- Textbook of Intellectual Property Rights, N.K. Acharya. Asia Law House, ed. 2021.
- Intellectual property right, Deborah. E. Bouchoux, Cengage learning.
- Intellectual Property Rights–Pandey Neeraj, Dharni Khushdeep. PHI.
- Intellectual Property Rights: Text and Cases R. Radhakrishnan, S. Balasubramanian. Excel Books.

Reference Books

1) Intellectual property right – Unleashing the knowledge economy, Prabuddha Ganguli, Tate McGraw Hill ltd.

2) A short course in International Intellectual Property Rights – Karla C. Shippey, World Trade Press.

3) Intellectual Property Rights – Heritage, Science, & Society under international treaties – A. Subbian, - Deep & Deep Publications – New Delhi.

HUMAN RIGHTS

Course Code:	**:**	**AUC 09**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture : , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes:

On completion of the course, students will be able to:

1. Simply put, human rights education is all learning that develops the knowledge, skills, and values of human rights.
2. Strengthen the respect for human rights and fundamental freedoms.
3. Enable all persons to participate effectively in a free society.
4. Learn about human rights principles, such as the universality, indivisibility, and interdependence of human rights.

UNIT-I

The Basic Concepts: Individual, Group, Civil Society, State, Equality, Justice, Human Values: Humanity, Virtues, Compassion.

UNIT-II **Human Rights and Human Duties:**

i) Philosophical and historical foundation of human rights and duties
ii) Theories of rights
iii) Concept and classifications of human rights and duties
iv) Human rights and duties

1. Correlation of rights and duties/responsibilities
2. Tensions between rights inter se, duties inter se, and rights and duties

UNIT-III

Society, Religion, Culture, and their Inter-Relationship: Impact of Social Structure on Human behavior, Roll of Socialization in Human Values, Science and Technology, Modernization, Globalization, and Dehumanization.

UNIT-IV

Social Structure and Social Problems: Social and Communal Conflicts and Social Harmony, Rural Poverty, Unemployment, Bonded Labour, Migrant workers and Human Rights Violations, Human Rights of mentally and physically challenged.

Books & References:

1. Shastry, T. S. N., India and Human rights: Reflections, Concept Publishing Company India (P Ltd), 2005.
2. Nirmal, C.J., Human Rights in India: Historical, Social and Political Perspectives (Law in India), Oxford India.

LOGICAL RESEARCH

Course Code: : **AUC 10** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination
Course outcome: In this course you should develop the following competencies:

CO1: To understand about research methodology with its different aspects, about logical reasoning, and types of research.
CO2: It will also result in knowledge appraisal from data collection to data interpretation.
CO3: Mathematical reasoning will also help them to acquire several skills required for the placement.

Course Content

UNIT1- Research Methodology: meaning, characteristics, Types of research; Process of research; Research methods and Ethical issues in research.

UNIT2- Logical Reasoning: arguments, deductive and inductive research, quantitative and qualitative research, scientific research; logical approach in research - Venn diagram; Inferences; analogies.

UNIT3- Data collection, Organization of data, Data analysis and mapping, Parametric and non-parametric; Data Interpretation.

UNIT4- Mathematical Reasoning, number series, letter series, codes; relationships, classification.

References:
1. Business Research Methods – Donald Cooper & Pamela Schindler, TMGH, 9th edition
2. Business Research Methods – Alan Bryman & Emma Bell, Oxford University Press.
3. Research Methodology – C.R.Kothari
4. Marketing Research- G C Beri
5. Logical reasoning- R S Agarwal

PROFESSIONAL ETHICS

Course Code: : **AUC 11** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:

Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

Course Outcomes

Course Outcomes: After the completion of the course the student will be able to-

CO1: Understand the core values that shape the ethical behaviour of a professional.

CO2: Identify the multiple ethical interests at stake in a real-world situation or practice.

CO3: Explain the role and responsibility in technological development by keeping personal ethics and legal ethics.

CO4: Solve moral and ethical problems through exploration and assessment by established experiments.

CO5: Apply the knowledge of human values and social values to contemporary ethical values and global issues.

Course Content

Unit I:

Understanding Professional Ethics and Human Values: Morals, values and Ethics – Integrity- Academic integrity-Work Ethics- Service Learning- Civic Virtue Respect for others- Living peacefully- Caring and Sharing- Honestly- courage-Cooperation commitment Empathy-Self Confidence -Social Expectations.

Unit II:

Ethics for Engineers: Ethics – its importance – code of ethics – person and virtues – habits and morals – 4 main virtues – ethical theories – Kohlberg's theory – Gilligan's theory – towards a comprehensive approach to moral behaviour – truth – approach to knowledge in technology.

Unit III:

Environmental Ethics and Sustainability: Problems of environmental ethics in engineering – engineering as profession serving people – engineer's responsibility to environment – principles of sustainability – industrial, economic, environmental, agricultural, and urban sustainability – Sustainable development. - Global Ethical Issues.

Unit IV:

Social Experimentation, Responsibility and Rights: Engineers and responsible experiments – safety and risk – confidentiality – knowledge gained confidentiality – experimental nature of engineering – Intellectual Property Rights – professional rights – employee rights – occupational crime.

Textbooks

- Mike W Martin, Roland Schinzinger, " Ethics in Engineering", Tata McGraw –Hill.
- Govindarajan M, Natarajan S, Senthil Kumar V S, "Engineering Ethics" PHI India.
- R.R Gaur, R Sangal, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

Reference Books

- Aarne Vesblind, Alastair S Gunn, "Engineering Ethics and the Enviornment".

- Edmund G Seebauer, Robert L Barry, "Fundamentals of Ethics for scientists and engineers" Oxford University Press.
- B L Bajpai, 2004, Indian Ethos and Modern Management, New Royal Book Co., Lucknow. Reprinted 2008.

ENVIRONMENTAL LAWS

Course Code: : **AUC 12** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : 1/2 Lecture : , Tutorial : , Practical:
Number of Credits :
Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.
Course Outcomes:

The course gives students the opportunity to grapple with contemporary legal debates in environment law. Therefore, the learning outcomes of this course can be encapsulated as follows:

1) The primary learning outcome is to sensitize the students towards human activities that adversely affect the environment and the need for regulation of such activities.
2) Students will develop a thorough understanding of practice and procedure followed by various environmental law enforcing agencies/bodies.
3) Students will be able to pursue environmental litigation before the National Green Tribunal and assist the Tribunal as a researcher or in any other capacity.
4) Students will be able to assist industries and projects in obtaining environmental clearance and compliances with other environmental laws.

UNIT-I

Development of Environmental Laws and Policies in India:

I. Concept of 'environment' and understanding scope of environmental law.
II. Two approaches towards environmental protection- 'Eco-centric approach' and 'Anthropocentric' approach.
III. Impact of IEL on environmental law in India.
IV. Significance of Environmental Protection in Five Year Plans.
V. Development of the 'Right to Environment' as a Fundamental Right and challenges.

UNIT-II **Judicial remedies and the role of National Green Tribunal:**

I. Civil Remedies i.e. Tortious remedy and Class Action

II. Criminal Law Remedies under relevant provisions of Indian Penal Code, 1860 and Criminal Procedure Code, 1973
III. Constitutional Law Remedies i.e. Writ Jurisdiction & Public Interest Litigation
IV. Statutory Remedies i.e. Remedies under Public Liability Insurance Act 1991, National Environment Tribunal Act, 1995, National Green Tribunal Act, 2010

UNIT-III

Statutory framework for Prevention of Environmental, Air and Water Pollution:

I. Water (Prevention and Control of Pollution) Act 1974 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Constitutional Challenges of Restraining Orders under Section 33]
II. The Air (Prevention and Control of Pollution) Act 1981 [Framework of the Act, Criminal Liability and Judicial relief under the Act, Noise Pollution]
III. Environment (Protection) Act, 1986 [Framework of the Act, Enforcement mechanisms and Role of Pollution Control Boards, Environment Impact Assessment, Coastal zone regulations Notifications]
IV. Law on Waste Management and Handling
V. Procedural environmental rights under various environmental laws
- Right to Information
- Right to public consultation
- Right of access to justice

UNIT-IV

Statutory framework governing Forest, Wildlife and Biodiversity:

II. Statutory Framework on Forest Preservation [The Indian Forest Act, 1927; Forest (Conservation) Act, 1980; National Forest Policy, 1988; The Scheduled Tribe and other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006]
III. Statutory Framework on Wildlife & Biodiversity Protection [The Wildlife (Protection) Act, 1972; Implementation and gaps and Judicial Perspective; Biological Diversity Act, 2002]

Books & References:

1) Shyam Divan & Armin Rosencranz, Environmental Law & Policy in India (2 nded, Oxford University Press, 2014)
2) P. Leelakrishnan, Environmental law in India (4th ed, LexisNexis, 2016)
3) Lavanya Rajamani and Shibani Ghosh, Indian Environmental Law: Key Concepts and Principles (Orient Blackswan, 2019)
4) Gitanjali Nain Gill, Environmental Justice in India: The National Green Tribunal (Routledge, 2017)
5) Patricia Birnie, Alan Boyle and Catherine Redgwell, International Law and the Environment (3rd ed., Oxford University Press, 2009)
6) Philippe Sands, Principles of International Environmental Law (2nd ed, Cambridge University Press, 2003)

HEALTH LAW

Course Code: : **AUC 13** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : ½ Lecture : , Tutorial : , Practical:
Number of Credits : 0 Credit

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination

Course Outcome: In this course you should develop the following competencies:
CO1: Knowledge and understanding of the values and policies underlying Health Law.
CO2: Knowledge and understanding of substantive law related to health care, health care insurance markets as well as related procedural law.
CO3: Written and oral communication in the legal context.

Course Content

UNIT-1 BASICS OF HEALTH LAW- Basic of Health and its provider, Origin & Evaluation, All Council Acts.

UNIT-2 NEED FOR HEALTH LAW -Fraudulence, Negligence and Abuse, Human Rights, Rights & Duties of Health Care Provider (Public & Private Activities).

UNIT-3 LEGAL ASPECTS OF HEALTH LAW- Role of Health Policy & Health Care Delivery, General Laws on Health Law (Medical Allied Agencies), Specific Laws on Health Law (NDT, PWD/etc.).

UNIT-4 MEDICAL INSURANCE –Introduction-Various types, Significance and Kind of Medical Insurance/Policies, Insurance & Assurance, General Principles of Law and Contract, Medical Insurance Regulations.

REFERENCES:
1)Jonathan Herring- Medical Law and Ethics
2)Mason and Mc Call Smith- Law and Medical Ethics
3)S. V. Jogarao- Current Issues in Criminal Justice and Medical Law

National Cadet Corps (NCC)

Course Code: : **AUC 14** **Credits (0-0-0)**
Course Category : **Audit**
Pre-requisite Subject : NIL
Contact Hours/Week : ½ Lecture : , Tutorial : , Practical:

Number of Credits : 0 Credit

Course Outcome: In this course you should develop the following competencies:

CO1: Imbibe the conduct of NCC cadets.
CO2: Respect the diversity of different Indian culture.
CO3: Perform his/her role in Nation Building
CO4: Do the social services on different occasions.
CO5: Practice togetherness and empathy in all walks of their life.
CO6: Do the asana and gain the physical& mental fitness

Course Content

UNIT 1
NCC General

History, Aims, Objective of NCC, NCC as Organization. Incentives of NCC, Duties of NCC Cadet, NCC Camps: Types & Conduct.

UNIT 2
National Integration & Awareness

National Integration: Importance & Necessity, Factors Affecting National Integration, Unity in Diversity & Role of NCC in Nation Building, Threats to National Security

UNIT 3
Social Service and Community Development

Celebration of Days of National & International Importance, Social Service and Community Development Activities to be conducted.

UNIT 4
Health & Hygiene:

Yoga- Introduction, Definition, Purpose, Benefits.
Asanas-Padamsana, Siddhasana, Gyan Mudra, Surya Namaskar, Shavasana, Vajrasana, Dhanurasana, Chakrasana, Sarvaangasana, Halasana etc.

Textbooks:

1. R. Gupta, "NCC: Handbook of NCC Cadets for 'A', 'B' and 'C' Certificate Examinations" 1st Edition (English, Paperback, RPH Editorial Board)

Basics of Human Health and Preventive Medicines

Course Code:	**:**	**AUC 15**	**Credits (0-0-0)**
Course Category	**:**	**Audit**	
Pre-requisite Subject	:	NIL	
Contact Hours/Week	:	1/2 Lecture: , Tutorial : , Practical:	
Number of Credits	:	0 Credit	

Course Assessment Methods: Continuous assessment through tutorials, attendance, home assignments, quizzes, practical, Tutorial class, viva voce and Minor tests and One Major Theory Examination.

UNIT- 1

Health- Definition, dimensions, concept of wellbeing, Physical quality of life index, Spectrum of health, Determinants of health.

Concept of disease- Epidemiological triad, Natural history of disease, Risk factors, risk group, Iceberg of disease, Disease control, Disease elimination, Disease eradication, **Monitoring and surveillance-** Concept of prevention, Primary, Secondary and Tertiary, Modes of Intervention.

UNIT- 2

Communicable diseases- Type of microorganisms, Mode of transmission, Prevention of infectious diseases, Vaccination/immunization**.**

Diarrheal diseases and dehydration- Prevention and role of ORS**.**

Fever- cause and how to deal with.

Respiratory problems and cough

UNIT - 3

Non communicable diseases/ Lifestyle related disorder- Risk factors, CAD, risk and prevention, Hypertension, Diabetes mellitus, Obesity, Cancer, Accidents.

UNIT – 4

Nutrition and health- Classification of food, Balance diet.

Occupational hazards

Mental health and substance abuse

Medical Emergencies- BLS and ALS.

Reference Textbook

1) K. Park – "Park's Textbook of Preventive and Social Medicine"
2) Yash Pal Bedi & Pragya Sharma– "Handbook of Preventive and Social Medicine, Seventeenth Edition, CBS Publication".
3) Sunder Lal, Adarsh, Pankaj – "Update on Textbook of Community Medicine Preventive and Social Medicine with Recent Advances" 5th Edition, Publication 2018.
4) Dr. B. Saha- "Preventive and Social Medicine Communicable Disease Hygiene".
5) Rabindra Nath Roy, Indernil Saha- "Mahajan and Gupta Textbook of Preventive and Social Medicine" 4th Edition, Japee

Detail Syllabus of Extra Curricular Activities (ECA) Courses under Council of Student Activities

Skill Development- I (ECA-151)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and IEEE:** An introduction to technical sub-council and IEEE. An overview of IEEE and the events conducted by them.

UNIT- 2

- **Robotics Classes:** Informative classes conducted on by the students of IEEE about Bot modelling and electronics as well as embedded. It is conducted for both Wired and Wireless Robotics.

UNIT- 3

- **Introduction to Workshops by IEEE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A number of workshops are conducted by IEEE like Ethical hacking, Soft skills, Artificial Intelligence etc.

UNIT- 4

- **Events under TechSrijan:** Techsrijan is the annual techno-management fest held every year like Enigma, Robotics, Incognito, Quizzes, World Parliament, etc.

Skill Development- II (ECA-201)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and SAE:** An introduction to technical sub-Council and SAE. An overview of SAE and the events conducted by them.

UNIT- 2

- **Aeromodelling Classes:** Informative classes and workshop conducted on by the students of SAE about Drone and remote-controlled modeling and electronics as well as embedded.

UNIT -3

- **Introduction to Workshops by SAE:** *Workshop* is a brief intensive course for a small group which emphasizes problem solving. A no. of workshops is conducted by SAE like Aeromodelling workshop, Bridge modeling etc.

UNIT- 4

- **Events under TechSrijan by SAE:** Techsrijan is the annual techno-management fest held every year. SAE conducts a number of events in TechSrijan like Junkyard Wars, Bride Kriti, El Tiro etc.

Skill Development- III (ECA-251)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and UIC:** The University Innovation Cell supports and provides opportunity for Innovation works. You will get to learn about the things they do and promote.

UNIT -2

- **Introduction to Innowizion:** Every year University Innovation Cell organizes a national level event that provides opportunities for students across all disciplines to team up and use their creativity, passion, and knowledge of technology. Events like I-Expo and I-Quiz.

UNIT- 3

- **Introduction to Spectra:** It is a special event organized by University Innovation Cell which foster an opportunity for students to showcase their creativity and talent. It comprises of three events InQUIZitive, Replica and MindBuzz**.**

UNIT- 4

- **Learnings and Innovation:** Innovation increases your chances to react to changes and discover new opportunities. It can also help foster competitive advantage as it allows you to build better products and services for your customers in the industry.

Skill Development- IV (ECA-301)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and SEB:** The Social Engineers Board (SEB) tries to achieve its goals by series of various events conducted throughout the academic year, both inside and outside the university.The members of the board are highly motivated individuals striving for noble cause, and voluntarily take initiatives which ensure betterment of the people and society in any way possible.

UNIT- 2

- **Introduction to Drishya:** A career counselling event by college final year, and an event designed to crave out the creativity inside the students and their ability to make something novel out of normality in situation

UNIT- 3

- **Introduction to Dhishan:** Bringing out the oration skill and leadership personality among the students by providing them chance to stand and represent themselves by this event.

UNIT -4

- **Introduction to Paravartan and NGOs:** Paravartan consists of a audio visual round and the second round is a skit presentation developing character of a student. They also collab with NGOs for social works.

Skill Development- Vth (ECA-351)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and E CELL:** E-Cell of Madan Mohan Malaviya University of Technology promotes entrepreneurship abilities among the students of the university and conducts events to promote these ideas.

UNIT- 2

- **Introduction to Fresher's Talk:** A creative talk with the freshers of our university in which the fresher students provide some insights of what and how are they feeling about the college and its environment.

UNIT- 3

- **Introduction to Start Up Week:** Understanding the aspects of and entrepreneurial background and train to become one, through various personality developing as well as professionally balanced events.

UNIT- 4

- **Entrepreneurship Development:** It is the process of enhancing the skillset and knowledge of entrepreneurs regarding the development, management and organization of a business venture while keeping in mind the risks associated with it. Students will learn and cultivate skills which will promote entrepreneurship.

Skill Development-VIth (ECA-401)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Participation and Training
Course Outcome	:	Students are expected to learn and develop their skill and their personality through the activities and trainings under the council and should be well versed with the listed activities and events.

UNIT- 1

- **Introduction to TSC and Robotics Club:** Robotics Club speaks a name for itself in this domain with a sheen of itself that has been set by the high standards of the club members and strict adherence to the tagline Transforming ideas into reality, Events Details

UNIT- 2

- **Introduction to Web D Classes:** Classes on web development helps students to develop skills like Front-end and Back-end development which they can use to make websites.

UNIT -3

- **Introduction to Engineers Week:** a seven-day event paying tribute to all the engineers across the globe by conducting a no. of exciting events for technical development of students.

UNIT- 4

- **Robomania:** Develop the knowledge of robotics and circuitry in the students through training of students on circuits and the conduction of Robo Wars, Electronic chess, diffusion of a bomb in a set up made by students, demonstration of live game of the virtual events of NFS and Tekken, Lazer strike, Designing of Lazer maze.

Unity and Discipline (NCC)-I (ECA-171)

Course Category	:	NCC
Pre Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Lecture & Practical
Course Outcome	:	After completing this course, the students will be able to:

- Imbibe the conduct of NCC cadets.
- Do the social services on different occasions.

UNIT -1
Introduction of NCC: History, Aims, Objective of NCC.

UNIT -2
NCC as Organization. Incentives of NCC, Duties of NCC Cadet.

UNIT -3
Celebration of Days of National & International Importance, Social Service and Community Development Activities

UNIT- 4
NCC Parade on Independence Day.

Unity and Discipline (NCC)-II – (ECA- 221)

Course Category	:	NCC
Pre Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Lecture & Practical
Course Outcome	:	After completing this course, the students will be able to: -

- Respect the diversity of different Indian culture.
- Do the social services on different occasions.

UNIT- 1
National Integration & Awareness, Importance & Necessity

UNIT- 2
Factors Affecting National Integration, Unity in Diversity

UNIT -3
Celebration of Days of National & International Importance, Social Service and Community Development Activities

UNIT- 4
NCC Parade on Republic Day.

Unity and Discipline (NCC)-III – (ECA-271)

Course Category	:	NCC
Pre Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Lecture & Practical
Course Outcome	:	After completing this course, the students will be able to: - • Perform his/her role in Nation Building. • Do the social services on different occasions.

UNIT- 1
Role of NCC in Nation Building.

UNIT- 2
Threats to National Security.

UNIT -3
Celebration of Days of National & International Importance, Social Service and Community Development Activities

UNIT- 4
NCC Parade on Independence Day.

Unity and Discipline (NCC)-IV- (ECA-321)

Course Category	:	NCC
Pre Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Lecture & Practical
Course Outcome	:	After completing this course, the students will be able to: - • Contribute to environmental awareness and conservation activities. • Develop Leadership Qualities. • Do the social services on different occasions.

UNIT -1
Environmental Awareness and Conservation.

UNIT -2
Leadership Development: Important Leadership traits, Indicators of leadership.

UNIT- 3
Celebration of Days of National & International Importance, Social Service and Community Development Activities

UNIT -4
NCC Parade on Republic Day.

National Service Scheme-I (ECA-172)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments.
Course Outcome	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

Introduction to National Service Scheme:

UINIT-I: History and its Objectives
UNIT-II: Organizational structure of N.S.S. at National, State, University and College Levels

UNIT-III: Advisory committee and their functions with special reference to University CSA, Program officer, N.S.S. group leader and N.S.S. volunteers in the implementation**.**

UNIT-IV: Organization/ Participation in "Tree-Plantation Drive"

National Service Scheme- II (ECA-222)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments.
Course Outcome	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

UNIT-I: National Integration, Need and importance of National integration

UNIT-II: Various obstacles in the way of National Integration, such as caste, religion, language and provisional problems etc.

UNIT-III: NSS related Activities: Awareness to various activities under NSS.

UNIT-IV: Organization/Participation in "Cleanliness Drive" at home, hostel, Department and University

UNIT-V: Organization/Participation in "Winter cloth collection and distribution to needy people"

National Service Scheme- III (ECA-272)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0

Course Assessment Method : Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments.

Course Outcome : The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers

shall strive for the well-being of the society.

UNIT-I: Special Programme in NSS-I

A) Legal awareness
B) Health awareness
C) First-aid

UNIT-II: Special Programme in NSS-II

A) Career guidance
B) Leadership training-cum-Cultural Programme
C) Globalization and its Economic Social Political and Cultural impacts.

UNIT-III: Special Camping programme in NSS-I

A) Nature and its objectives
B) Selection of campsite and physical arrangement
C) Organization of N.S.S. camp through various committees and discipline in the camp.

UNIT-IV: Special Camping programme in NSS-I

A) Activities to be undertaken during the N.S.S. camp.
B) Use of the mass media in the N.S.S. activities.

National Service Scheme- IV (ECA-322)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	NIL
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Continuous assessment through National Service Scheme related tasks, participation in different events organized, attendance, home assignments.
Course Outcome	:	The students are expected to be able to demonstrate the following knowledge, skills and attitudes in achieving NSS motto after completing this course:

- The Motto of NSS "Not Me but You", reflects the essence of democratic living and upholds the need for self-less service.
- NSS helps the students' development & appreciation to other person's point of view and also show consideration towards other living beings.
- The philosophy of the NSS is a good doctrine in this motto, which underlines on the belief that the welfare of an individual is ultimately dependent on the welfare of the society as a whole and therefore, the NSS volunteers shall strive for the well-being of the society.

UNIT-I: N.S.S. Regular Activities-I

A) Traffic regulation
B) Working with Police Commissioner's Office
C) Working with Corporation of Gorakhpur District

UNIT-II: N.S.S. Regular Activities-II

A) Working with Health Department
B) Blind assistance
C) Garments collection and distribution

UNIT-III: N.S.S. Regular Activities-III

A) Non-formal Education
B) Environmental Education Awareness and Training (EEAT)'
C) Blood donation

UNIT-IV: N.S.S. Regular Activities-IV

A) Adopted Village related works
B) Disaster/Pandemic management

GAMES & SPORTS-I (ECA-181)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills, and attitudes after completing this course.

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track.

Track & Field-

UNIT- 1

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

UNIT- 2

- **FUNDAMENTAL SKILLS:**

- Starting techniques: Standing start, Crouch start and its variations, Proper use of blocks.
- Finishing Techniques: Run, Through, Forward lunging, Shoulder Shrug.

UNIT- 3

- **FUNDAMENTAL SKILLS-II:**

- Various patterns of Baton Exchange.
- Understanding of Relay Zones.
- Rules & their interpretation.

UNIT- 4

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Track & Field

Books & References

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

GAMES & SPORTS-II (ECA-231)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. • Understand the concept of skill. • Acquire the required motor skills. • Demonstrate and assess various techniques of starts and finish. • Interpret the rules & regulations. • Acquire skill of marking track.

Basketball-

UNIT- 1

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

UNIT- 2

- **FUNDAMENTAL SKILLS- I:**

- Player stance and ball handling.
- Passing-Two Hand chest pass, Two hand Bounce Pass, One Hand Baseball pass, Side Arm Pass, Over Head pass, Hook Pass.
- Receiving-Two Hand receiving, One hand receiving, Receiving in stationary position, Receiving while jumping, Receiving while running.

UNIT- 3

- **FUNDAMENTAL SKILLS- II:**

- Dribbling-How to start dribble, how to drop dribble, High dribble, Low dribble, Reverse dribble, Rolling dribble.
- Shooting-Lay-up shot and its variations, one hand set shot, one hand jump shot, Hook shot, and Free throw.
- Individual Defensive-Guarding the man with and without the ball, pivoting.

UNIT- 4

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

Books & References

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

GAMES & SPORTS-III (ECA-281)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track

Volleyball-

UNIT- 1

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

UNIT- 2

- **FUNDAMENTAL SKILLS-I:**
- Service-Under Arm Service, Tennis Service, Floating Service.
- Overhead finger pass.
- The Dig (Under Arm pass).

UNIT- 3

- **FUNDAMENTAL SKILLS –II:**
- Back court defense.
- Defensive and Offensive strategies.
- Smash
- Block–individual and team.

UNIT- 4

- **FUNDAMENTAL SKILLS-III:**
- Drills and Lead-up Games.
- Marking and Layout of Field.

Books & References

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

GAMES & SPORTS-IV (ECA-331)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. • Understand the concept of skill. • Acquire the required motor skills. • Demonstrate and assess various techniques of starts and finish. • Interpret the rules & regulations. • Acquire skill of marking track for running events.

Hockey-

UNIT-1

- **INTRODUCTION:**

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International

UNIT- 2

- **FUNDAMENTAL SKILLS-I:**
- Player stance & Grip,
- Rolling the ball, Dribbling.
- Push, Stopping.
- Hit, Flick, Scoop.
- Reverse hit.

UNIT- 3

- **FUNDAMENTAL SKILLS-II:**
- Passing–Forward pass, square pass, triangular pass, diagonal pass, return Pass.
- Goalkeeping–Hand defense, foot defense.
- Positional play in attack and defense.

UNIT- 4

- **FUNDAMENTAL SKILLS-III:**
- Drills and Lead-up Games.
- Marking and Layout of Court.

Books & References

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

GAMES & SPORTS- V (ECA- 381)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course. • Understand the concept of skill. • Acquire the required motor skills. • Demonstrate and assess various techniques of starts and finish. • Interpret the rules & regulations. • Acquire skill of marking track for running events.

UNIT 1

- **YOGA- HOLISTIC HEALTH:**

 Health- Concept of Health, its importance in human life.

 Components of health.

UNIT-II

- **YOGA AND ITS IMPORTANCE:**

- Definition of Yoga.
- Importance of Yoga in daily life.
- Aims and Objective of yoga.
- Misconception of yoga.

UNIT-III

- **SURYA NAMASKAR:**

- Benefits of Surya Namaskar
- Practices of Surya Namaskar

Unit- IV

- **YOGA PRACTICES:**

 Asana- Meditative
  i) Sukhasana
  ii) Padmasana
  iii) Swastikasana

 Cultural- Trikonasana, Makarasana, Bhujangasana, Sarpasana, Dhanurasana.

 Pranayama- Yogic Breathing, Anulom-Vilom.

Books & References

1. Indra Devi, “Yoga For You”, Gibbs, Smith publishers, Salt Lake City, 2002 Domen& Publishers, New Delhi-2001.
2. Yoga se Arogya, Indian Yoga Society, Sagar.

Games & Sports -VI (ECA- 431)

Course Category	:	Extra-Curricular Activities
Pre-Requisite	:	Physical Education at 12th standard
Contact/Hours of Work	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Method	:	Practical Training and Practices.
Course Outcome	:	The students are expected to be able to perform the following Knowledge, skills and attitudes after completing this course.

- Understand the concept of skill.
- Acquire the required motor skills.
- Demonstrate and assess various techniques of starts and finish.
- Interpret the rules & regulations.
- Acquire skill of marking track for running events.

UNIT- 1

- **Badminton**

INTRODUCTION:

Historical development

- National
- International

Structure and functions of Controlling Bodies

- National
- International.

UNIT-II

- **FUNDAMENTAL SKILLS-I:**

- Racket parts, Racket grips, Shuttle (dimensions).
- The basics stances.
- Basic foot movements.

UNIT-III

- **FUNDAMENTAL SKILLS-II:**

- The basic strokes-Serves.
- Forehand-overhead and underarm.
- Backhand-overhead and underarm.
- Types of games-Singles, doubles, including mixed doubles.

Unit- IV

- **FUNDAMENTAL SKILLS-III:**

- Drills and Lead-up Games.
- Marking and Layout of Court.

Books & References

1. Latest Official Rule Books of International Federation
2. Coaching Manuals of International Federation
3. Official Website

Culture, Art & Literary-I (ECA-182)

Course category	:	Cultural, Art &Literary
Pre-requisite Subject	:	NIL
Contact hours/week	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Methods	:	Practical Participation
Course Outcomes	:	Students are expected to develop their soft skills and their Personality through cultural and literary activities.

UNIT-1

Workout, Warm up, Stretching, Introduction to various dance forms, Dance form – Bollywood, Footwork, Body Movement, Theatre History, Literature and Aesthetics, Introduction to Acting, Yoga(Breathing, Exercise, Voice Control and Sound Modulation).

UNIT-2

Introduction to music, Basic Terminologies related to music, Origin of sound, Historical study of musical terms, Basic Introduction to Fine Arts, Roll of FAC in cultural sub-council, Basics of Fine Arts and Types, File extension, Editing software, Resources for stock images and video.

UNIT-3

MALVIKA: Basic knowledge of designing software (I) : Adobe In Design ,Photoshop ,Notice Making, Article writing.

UNIT-4

TIRESIA: Basic knowledge of designing software (I): Adobe In Design, Photoshop, Interview skills, Vocabulary development, Knowledge about technical advancements, knowledge of campus activities.

Culture, Art & Literary-II (ECA-232)

Course category	:	Cultural, Art &Literary
Pre-requisite Subject	:	NIL
Contact hours/week	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Methods	:	Practical Participation
Course Outcomes	:	Students are expected to develop their soft skills and their personality through cultural and literary activities.

UNIT-1

Intro to basics of sketching, Painting, Craft, Sculpturing.

Sketch-Tools of sketching, Types of Sketching- Pencil/ Pen/ Color Pencil/ Charcoal/ Graphite/Ink/ Chalk / Digital Sketch. History of Indian Music, About life and contributions of Indian Musician sand Musicologists.

Two forms of Indian Classical Music (Hindustani/Karnataka).

UNIT-2

Introduction to Theatre Technique and Design, Character Analysis and practical on principle of Stanislavski Method (relaxations, concentration of attention and emotion memory), Workout, Warm up, Stretching, Dance Form- Hip-Hop, Footwork, Body movement, Choreography, Equipment, Types of lenses, building web site using template.

UNIT-3

ARUNODAY: Development of thinking ability with JAM (Just a Minute), Word Building, Letter rearrangement, Knowledge of spellings, Syllables, Critical thinking skill development, Vocabulary development, Thought expressing skill development, public speaking skill development.

UNIT-4

SPELLCZAR: Word building, Vocabulary development, Decision making ability development, Coordination capabilities.

Culture, Art & Literary-III (ECA-282)

Course category	:	Cultural, Art &Literary
Pre-requisite Subject	:	NIL
Contact hours/week	:	2 Hours/Week
Number of Credits	:	0
Course Assessment Methods	:	Practical Participation
Course Outcomes	:	Students are expected to develop their soft skills and their personality through cultural and literary activities.

UNIT-1

Photo editing (Photoshop)

Ras- (Sringar Ras, Hasya Ras, Rodra Ras, Karun Ras, Vir Ras, Adbhut Ras, Vibath Ras, Bhayanak Ras, Shaant Ras)

UNIT-2

Workout, Warmup, Stretching, Pranam, Types of classical dance forms and their outfits, Dance form-Kathak, Hand movements, Choreography, Basic knowledge of Talas for Instance Teental, Dadra and Kherwa, Practice of AUM and vocal exercises of sargam (sa, re, ga, ma, pa, dha, ni) of 45. Alankaras, Styles of Sketching-Line/ Hatching/Blending/Scribbles/Tattoo/Doodling/Cartoon/Graffiti/Typography/Calligraphy/Caricat Ure

UNIT-3

ANNUAL DEBATE COMPETITION: General Knowledge & Current Affairs, Public speaking skill development, Oratory skill development, Sense of Team spirit, Knowledge of language, Social Study, Development of presentation skills.

UNIT-4

TWIST AND TWAIN: Development of imaginative power and creativity, Development of vocabulary, Development of writing skills, Thinking skill development.

Culture, Art & Literary-IV (ECA-332)

Course category	:	Cultural, Art &Literary
Pre-requisite Subject	:	NIL
Contact hours/week	:	2 Hours/Week
Number of Credits	:	0
Course Assessment methods	:	Practical Participation
Course Outcomes	:	Students are expected to develop their soft skills and their Personality through cultural and literary activities.

UNIT-1

Video editing, Basic knowledge about musical instruments (Tabla, flute, guitar etc.) about Swarmalika and two bragas-Bhupaliand Yaman.

UNIT-2

Monologue, reciting a poem, reading short stories, developing speech skill, Mime, Working on scene with partner and in a group, Painting-Tools of painting, Styles of painting-Abstract/Imagination/Expression/Cubism/Indian/Chinese/Japanese, All the theory covered upto Praveshi ka Purna, define and explain Kataaksha,Primalu, Nartan Bhedas- Nritta Nrutya and Natya, define Tandav and Lasya, Fourty pesof neck movements according to Abhinaya Darpan, Eight types of eye movements according to Abhinaya Darpan, Define and differentiate "FolkDance" and "Modern Dance" (Uday Shankar style), Life story of: Bindadin Maharaj, Kalka Prasadji, Harihar Prasadji& Hanuman Prasadji, Specialty of Jaipur and Lucknow Gharana,Definition and uses of the following Asanyukta Hasta Mudras: Sarpsheersha, Murga-sheersha, Simha-Mukha, Kangula, Alapadma, Chatura, Bhrama, Hansasya, Hansa-paksha, Sandausha, Mukula, Tamrachuda, Vyagraha, Trishula, Sanyukta HastaMudra: Anjali, Kapota, Karkata, Swastik, Dola, Pushpaputa, Utsanga, Shivalinga, Katakawardhan, Kartari-swastk, Shakata, Shankha.

UNIT-3

VAGMITA1: Development of oratory skill, Development of poetry writing skill, Alankar, Ras, Creative thinking ability development.

UNIT-4

VAGMITA 2: How to overcome camera consciousness, enhancement of the expression and presentation of the participants, development of the public speaking skill, Knowledge of tone adjustment while presenting.

Culture, Art & Literary-V (ECA-382)

Course category	: Cultural, Art &Literary
Pre-requisite Subject	: NIL
Contact hours/week	: 2 Hours/Week
Number of Credits	: 0
Course Assessment methods	: Practical Participation
Course Outcomes	: Students are expected to develop their soft skills and their personality

UNIT-1

Types of painting-Oil painting/ Watercolor painting/ Pastel painting/ Acrylic painting/ Digital painting/Spray Painting, Basic of Contemporary Dance, Foot Position and Transference, Center Technique, Travelling Technique, Dance, Dance (A) Peter Pan, dance (B) Emergence of a Butterfly.

UNIT-2

Improvisation, Elementary knowledge of Acting, Body language, Rhythm, Clarity and fluency in dialogue delivery, Understanding the depth of character, about terms related to Hindustani music like Naad, Shuruti, Saptak, Thaat, Vaadi, Samvadi, Photography Skill.

UNIT-3

MALAVIYAN THINKER: Creative thinking, how to pen down thoughts of our mind, Development of writing skill, Development of Expression, Public Speaking skill development.

UNIT-4

ABHYUDAYA: Multidimensional skill development: Technical skill development with software like Adobe Photoshop, MS word, MS PowerPoint, MS Excel, Content Writing skill development, public addressing, public engagement, Team work Mechanism, Leadership qualities, Time management, art and craft, Pottery, Oratory skill development, Presentation skill, Event management.

Culture, Art & Literary-VI (ECA-432)

Course category	: Cultural, Art &Literary
Pre-requisite Subject	: NIL
Contact hours/week	: 2 Hours/Week
Number of Credits	: 0
Course Assessment methods	: Practical Participation

Course Outcomes : Students are expected to develop their soft skills and their personality

UNIT-1

Cinematography, Basic knowledge of Thaat system, Raga formation rules, 5 Ragas- Bhupali, Yaman, Bihag, Kafi, Deskar.

UNIT-2

Introduction to Nukkad, Mono Act, Skit, Introduction to Comedy, Tragic Comedy, Tragedy, Melodrama, Craft- Tools of craft, Types of Craft- paperwork/ Wood work/ foam work/ Cloth work, Popping/ Introto music theory, Angles and Movement/Music Theory, Direction and Levels/Rhythms for Grooves, Twists and isolated movements/8 Count Phrasing, Footwork/Floats and Glides, Waves/Movements Dynamics, Waves 2/Musical Phrasing, Putting it all together.

UNIT-3

WRITING SKILLS: Invitation making, Notice making, Article writing.

SKILL FOR INTEVIEWER: How to take formal interview, approaching the personality, Questions preparation, management, platform selection, public engagement.

UNIT-4

INTERVIEW SKILLS FOR INTERVIEWEE: Body language, Attire, Hand gestures, voice tone, Language, General Interview Questions- How to introduce yourself.