

Curriculum for
Diploma Programme in
MECHANICAL ENGINEERING
For the State of Uttar Pradesh



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CONTENTS

Sr. No	Particulars	Page No.
-	Preface	(i)
-	Acknowledgement	(ii)
1.	Salient Features of the Diploma Programme	1
2.	Employment Opportunities	3
3.	Learning Outcomes of Diploma Programme in Mechanical Engineering	4
4.	Deriving Curriculum Areas from Learning Outcomes of the Programme	6
5.	Abstract of Curriculum Areas	9
6.	Horizontal and Vertical Organization of the Subjects	11
7.	Study and Evaluation Scheme	12
8.	Guidelines (for Assessment of Student Centered Activities and Internal Assessment)	18
9.	Detailed Contents of various Subjects	19

FIRST SEMESTER

1.1	Communication Skills-I	19
1.2	Applied Mathematics - I	22
1.3	Applied Physics – I	25
1.4	Applied Chemistry	31
1.5	Engineering Drawing-I	36
1.6	Basics of Information Technology	40
1.7	General Workshop Practice-I	45

SECOND SEMESTER

2.1	Applied Mathematics - II	49
2.2	Applied Physics -II	51
2.3	Applied Mechanics	55
2.4	General Engineering	59
2.5	Engineering Drawing -II	64
2.6	General Workshop Practice-II	67

THIRD SEMESTER

3.1	Applied Mathematics-III	70
3.2	Engineering Materials	73
3.3	Mechanics of Solids	77
3.4	Thermal Engineering	82
3.5	Computer Aided Drafting and 3D Modelling	87
3.6	Workshop Technology	90

FOURTH SEMESTER

4.1	Communication Skills-II	95
4.2	Refrigeration and Air Conditioning	98
4.3	Hydraulics and Pneumatics	102
4.4	Computer Aided Design and Manufacturing	106
4.5	Environmental Studies	110
4.6	Energy Conservation	113
4.7	Universal Human Values	118

FIFTH SEMESTER

-	Industrial Training	122
5.1	Industrial Management and Entrepreneurship Development	123
5.2	Theory of Machines	127
5.3	Machine Design	130
5.4	Production Technology	134
5.5	Production Management	141
5.6	Automobile Engineering	145

SIXTH SEMESTER

6.1	Industrial Engineering	149
6.2	Metrology and Measuring Instruments	153
6.3	CNC Machines and Automation	157
6.4	Elective	161
6.5	Project Work	166

10.	Resource Requirement	169
11.	Evaluation Strategy	185
12.	Recommendations for Effective Implementation of Curriculum	188
13.	List of Participants	191

PREFACE

An important issue generally debated amongst the planners and educators world over is how technical education can contribute to sustainable development of the societies struggling hard to come in the same bracket as that of the developed nations. The rapid industrialization and globalization has created an environment for free flow of information and technology through fast and efficient means. This has led to shrinking of the world, bringing people from different culture and environment together and giving rise to the concept of world turning into a global village. In India, a shift has taken place from the forgettable years of closed economy to knowledge based and open economy in the last few decades. In order to cope with the challenges of handling new technologies, materials and methods, we have to develop human resources having appropriate professional knowledge, skills and attitude. Technical education system is one of the significant components of the human resource development and has grown phenomenally during all these years. Now it is time to consolidate and infuse quality aspect through developing human resources, in the delivery system. Polytechnics play an important role in meeting the requirements of trained technical manpower for industries and field organizations. The initiatives being taken by the State Board of Technical Education, UP to revise the existing curricula of 6 diploma programmes as per the needs of the industry and making them NSQF compliant, are laudable.

In order to meet the requirements of future technical manpower, we will have to revamp our existing technical education system and one of the most important requirements is to develop outcome-based curricula of diploma programmes. The curricula for diploma programmes have been revised by adopting time-tested and nationally acclaimed scientific method, laying emphasis on the identification of learning outcomes of diploma programme.

The real success of the diploma programme depends upon its effective implementation. However best the curriculum document is designed, if that is not implemented properly, the output will not be as expected. In addition to acquisition of appropriate physical resources, the availability of motivated, competent and qualified faculty is essential for effective implementation of the curricula.

It is expected of the polytechnics to carry out job market research on a continuous basis to identify the new skill requirements, reduce or remove outdated and redundant courses, develop innovative methods of course offering and thereby infuse the much needed dynamism in the system.

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Coordinator

1. SALIENT FEATURES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

- 1) Name of the Programme : Diploma Programme in Mechanical Engineering
- 2) Duration of the Programme : Three years (Six Semesters)
- 3) Entry Qualification : Matriculation or equivalent NSQF Level as Prescribed by State Board of Technical Education, UP
- 4) Intake : 60 (or as prescribed by the Board)
- 5) Pattern of the Programme : Semester Pattern
- 6) NSQF Level : Level - 5
- 7) Ratio between theory and : 47 : 53 (Approx.)

Practice

- 8) Industrial Training:
Four weeks of industrial training is included after IV semester during summer vacation. Total marks allotted to industrial training will be 50.
- 9) Ecology and Environment :

As per Govt. of India directives, a subject on Environmental Studies has been incorporated in the curriculum.
- 10) Energy Conservation:

A subject on Energy Conservation has been incorporated in the curriculum.
- 11) Entrepreneurship Development:
A full subject on Industrial Management and Entrepreneurship Development has been incorporated in the curriculum.
- 12) Student Centred Activities:

A provision of 3-6 periods per week has been made for organizing Student Centred Activities for overall personality development of students. Such activities will comprise of co-curricular activities such as expert lectures, self study, games, hobby classes like photography, painting, singing etc. seminars, declamation contests, educational field visits, NCC, NSS and other cultural activities, disaster management and safety etc.
- 13) Project work

A project work has been included in the curriculum to enable the student get familiarize with the practices and procedures being followed in the industries and provide an opportunity to work on some live projects in the industry.

2. EMPLOYMENT OPPORTUNITIES FOR DIPLOMA HOLDERS IN MECAHNICAL ENGINEERING

The following are the major employment opportunities for diploma holders in Mechanical Engineering:

- In manufacturing industry primarily in private sector and to some extent in public sector
- In service sector like Railways, Hospitals, Military Engineering Services, Boards and Corporations, Construction Companies, Transportation Departments, Telecommunication, PWD and Rural Development Agencies.
- In marketing sector for sales and after- sales services
- As an entrepreneur

Though the diploma holders in Mechanical Engineering find placement in all functional areas like R&D, planning, shop floor production, quality control, inventory management but majority of them find employment in shop floor management.

3. LEARNING OUTCOMES OF DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

After undergoing this programme, students will be able to:

1.	Prepare and interpret drawings of engineering components.
2.	Use software like AutoCAD and Solid Works to prepare and analyze solid models.
3.	Prepare simple jobs as per specifications.
4.	Operate conventional machine for machining of components as per specifications
5.	Use cutting tools for machines and machine tools.
6.	Carry out casting and welding operation.
7.	Use modern machining methods for machining of components.
8.	Carry out metal forming by rolling and forging processes to produce parts.
9.	Use presses and press tools.
10.	Prepare simple jigs, fixtures, pattern, mould and press tools for production purposes.
11.	Use surface coating and protection methods.
12.	Prepare CNC part programmes and use CNC machines to make simple jobs. Interface CAD/CAM machines.
13.	Supervise operation of boilers, steam turbines, air compressors, IC engines, refrigeration and air-conditioning equipment.
14.	Use hydraulic and pneumatic equipment.
15.	Use electrical and electronic instruments to measure various engineering parameters.
16.	Use various measuring and gauging instruments.
17.	Perform material testing for its properties using traditional and nondestructive techniques (NDT)
18.	Use various instruments to measure heat/air related parameters.
19.	Use heat treatment processes.
20.	Design and modify simple machine elements.
21.	Select material as per desired application.
22.	Select and use QC tools.
23.	Identify and rectify simple and common troubles in automotive vehicles.
24.	Carry out estimation and costing of production cost for budgeting and analysis.
25.	Prepare process plan for given part.
26.	Carry out work measurement and method study to improve productivity.
27.	Use appropriate practices for conservation and prevention of environment pollution.
28.	Interpret factory acts and laws.

29.	Communicate effectively in English in oral and written form with others.
30.	Manage resources effectively at workplace.
31.	Plan and execute given task/project as a team member or leader.
32.	Prepare detailed project proposal and report.
33.	Use computer and IT tools for creating document, making spread sheet and making presentation.
34.	Solve real life problems by application of acquired knowledge and skills.
35.	Handle the customers effectively.
36.	Apply concepts of Mechanics to solve engineering problems.
37.	Apply basic principles of Mathematics and Science to solve engineering problems.
38.	Apply inventory control techniques to reduce production cost.
39.	Interpret basic hydraulic and thermodynamics processes / cycles.
40.	Manage activities related to procurement, stacking, storage and preservation of materials.
41.	Prepare maintenance schedules.

4. DERIVING CURRICULUM AREAS FROM LEARNING OUTCOMES OF THE PROGRAMME

The following curriculum areas/subjects have been derived from learning outcomes:

Sr. No.	Learning Outcomes	Curriculum Areas/Subjects
1.	Prepare and interpret drawings of engineering components.	– Engineering Drawing
2.	Use software like AutoCAD and Solid Works to prepare and analyze solid models.	– Computer Aided Drafting and 3D Modelling
3.	Prepare simple jobs as per specifications.	– General Workshop Practice
4.	Operate conventional machine for machining of components as per specifications	– Workshop Technology
5.	Use cutting tools for machines and machine tools.	– General Workshop Practice – Design and Estimation
6.	Carry out casting and welding operation.	– Workshop Technology
7.	Use modern machining methods for machining of components.	– Advanced Manufacturing Processes
8.	Carry out metal forming by rolling and forging processes to produce parts.	– Production Technology – Workshop Technology
9.	Use presses and press tools.	– Production Technology
10.	Prepare simple jigs, fixtures, pattern, mechanism, mould and press tools for production purposes.	– Production Technology – Theory of Machines
11.	Use surface coating and protection methods.	– Production Technology
12.	Prepare CNC part programmes and use CNC machines to make simple jobs. Interface CAD/CAM machines.	– CNC Machines and Automation
13.	Supervise operation of boilers, steam turbines, air compressors, IC engines, refrigeration and air-conditioning equipment.	– Thermodynamics – Refrigeration and Air Conditioning
14.	Use hydraulic and pneumatic equipment.	– Hydraulics and Pneumatics
15.	Use electrical and electronic instruments to measure various engineering parameters.	– General Engineering
16.	Use various measuring and gauging instruments.	– Metrology and Measuring Instruments
17.	Perform material testing for its properties using traditional and nondestructive techniques (NDT)	– Engineering Materials
18.	Use various instruments to measure heat/air	– Refrigeration and Air

	related parameters.	Conditioning
19.	Use heat treatment processes.	– Engineering Materials
20.	Design and modify simple machine elements.	– Computer Aided Design and Manufacturing – Design and Estimation
21.	Select material as per desired application.	– Engineering Materials
22.	Select and use QC tools.	– Metrology and Measuring Instruments
23.	Identify and rectify simple and common troubles in automotive vehicles.	– Automobile Engineering – Repair and Maintenance
24.	Carry out estimation and costing of production cost for budgeting and analysis.	– Design and Estimation
25.	Prepare process plan for given part.	– Industrial Engineering and Safety
26.	Carry out work measurement and method study to improve productivity.	– Industrial Engineering and Safety
27.	Use appropriate practices for conservation of energy and prevention of environment pollution.	– Environmental Studies – Energy Conservation
28.	Interpret factory acts and laws.	– Industrial Management and Entrepreneurship Development
29.	Communicate effectively in English in oral and written form with others.	– Communication Skills – Student Centred Activities (SCA)
30.	Manage resources effectively at workplace.	– Industrial Management and Entrepreneurship Development
31.	Plan and execute given task/project as a team member or leader.	– Industrial Engineering and Safety
32.	Prepare detailed project proposal and report.	– Project Work
33.	Use computer and IT tools for creating document, making spread sheet and making presentation.	– Basics of Information Technology
34.	Solve real life problems by application of acquired knowledge and skills.	– Project Work – Repair and Maintenance
35.	Handle the customers effectively.	– Industrial Management and Entrepreneurship Development
36.	Apply concepts of Mechanics to solve engineering problems.	– Applied Mechanics – Mechanics of Solids
37.	Apply basic principles of Mathematics and Science to solve engineering problems.	– Applied Mathematics – Applied Physics – Applied Chemistry
38.	Apply inventory control techniques to reduce	– Industrial Engineering and Safety

	production cost.	
39.	Interpret basic hydraulic and thermodynamics processes / cycles.	– Thermodynamics – Hydraulics and Pneumatics
40.	Manage activities related to procurement, stacking, storage and preservation of materials.	– Industrial Engineering and Safety
41.	Prepare maintenance schedules.	– Industrial Engineering and Safety

5. ABSTRACT OF CURRICULUM AREAS

a) General Studies

1. Communication Skills
2. Environmental Studies
3. Energy Conservation

b) Applied Sciences

4. Applied Mathematics
5. Applied Physics
6. Applied Chemistry

c) Basic Courses in Engineering/Technology

7. Engineering Drawing
8. General Workshop Practice
9. General Engineering
10. Basics of Information Technology

d) Applied Courses in Engineering/Technology

11. Engineering Materials
12. Mechanics of Solids
13. Computer Aided Drafting and 3D Modelling
14. Workshop Technology
15. Refrigeration and Air Conditioning
16. Hydraulics and Pneumatics
17. Computer Aided Design and Manufacturing
18. Industrial Management and Entrepreneurship Development
19. Theory of Machines
20. Design and Estimation
21. Production Technology
22. Advanced Manufacturing Processes
23. Industrial Engineering and Safety
24. Metrology and Measuring Instruments
25. CNC Machines and Automation
26. Automobile Engineering

e) Industrial Training

27. Project Work

f) Elective

28. Repair and Maintenance

29. Tool Engineering

6. HORIZONTAL AND VERTICAL ORGANISATION OF THE SUBJECTS

Sr. No.	Subjects	Distribution in Periods per week in Various Semesters					
		I	II	III	IV	V	VI
1.	Communication Skills	6	-	-	6	-	-
2.	Applied Mathematics	5	5	5	-	-	-
3.	Applied Physics	7	7	-	-	-	-
4.	Applied Chemistry	7	-	-	-	-	-
5.	Engineering Drawing	8	8	-	-	-	-
6.	Basics of Information Technology	6	-	-	-	-	-
7.	General Workshop Practice	8	8	-	-	-	-
8.	Applied Mechanics	-	7	-	-	-	-
9.	General Engineering	-	8	-	-	-	-
10.	Engineering Materials	-	-	6	-	-	-
11.	Mechanics of Solids	-	-	7	-	-	-
12.	Thermodynamics	-	-	9	-	-	-
13.	Computer Aided Drafting and 3D Modelling	-	-	8	-	-	-
14.	Workshop Technology	-	-	10	-	-	-
15.	Refrigeration and Air Conditioning	-	-	-	8	-	-
16.	Hydraulics and Pneumatics	-	-	-	8	-	-
17.	Computer Aided Design and Manufacturing	-	-	-	10	-	-
18.	Environmental Studies	-	-	-	5	-	-
19.	Energy Conservation	-	-	-	5	-	-
20.	Universal Human Values				3		
21.	Industrial Management and Entrepreneurship Development	-	-	-	-	5	-
22.	Theory of Machines	-	-	-	-	7	-
23.	Design and Estimation	-	-	-	-	7	-
24.	Production Technology	-	-	-	-	13	-
25.	Advanced Manufacturing Processes	-	-	-	-	5	-
26.	Automobile Engineering	-	-	-	-	5	-
27.	Elective	-	-	-	-	-	5
28.	Industrial Engineering and Safety	-	-	-	-	-	8
29.	Metrology and Measuring Instruments	-	-	-	-	-	9
30.	CNC Machines and Automation	-	-	-	-	-	8
31.	Project Work	-	-	-	-	-	12
32.	Student Centred Activities (SCA)	1	5	3	3	6	6
Total		48	48	48	48	48	48

7. STUDY AND EVALUATION SCHEME FOR DIPLOMA PROGRAMME IN MECHANICAL ENGINEERING

FIRST SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
1.1	*Communication Skills-I	4	-	2	4	20	10	30	50	2 ½	20	3	70	100		
1.2	*Applied Mathematics - I	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
1.3	*Applied Physics – I	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
1.4	*Applied Chemistry	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
1.5	*Engineering Drawing-I	-	-	8	2	-	40	40	60	3	-	-	60	100		
1.6	*Basics of Information Technology	-	-	6	2	-	40	40	-	-	60	3	60	100		
1.7	General Workshop Practice-I	-	-	8	2	-	40	40	-	-	60	4	60	100		
#Student Centred Activities (SCA)		-	-	1	1	-	30	30	-	-	-	-	-	30		
Total		19	-	29	25	80	180	260	260		180	-	440	700		

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

SECOND SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
2.1	*Applied Mathematics - II	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
2.2	*Applied Physics -II	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.3	+Applied Mechanics	5	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.4	General Engineering	6	-	2	5	20	10	30	50	2 ½	20	3	70	100		
2.5	*Engineering Drawing -II	-	-	8	2	-	40	40	60	3	-	-	60	100		
2.6	General Workshop Practice-II	-	-	8	2	-	40	40	-	-	60	4	60	100		
#Student Centred Activities (SCA)		-	-	5	1	-	30	30	-	-	-	-	-	30		
Total		21	-	27	24	80	140	220	260	-	120	-	380	600		

* Common with other diploma programmes

+ Common with diploma in Chemical Engg. and Civil Engg.

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

THIRD SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME										Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT							
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot			
3.1	*Applied Mathematics-III	5	-	-	4	20	-	20	50	2 ½	-	-	50	70		
3.2	Engineering Materials	4	-	2	4	20	10	30	50	2 ½	20	3	70	100		
3.3	Mechanics of Solids	4	1	2	5	20	10	30	50	2 ½	20	3	70	100		
3.4	Thermal Engineering	5	1	3	6	20	10	30	50	2 ½	20	3	70	100		
3.5	Computer Aided Drafting and 3D Modelling	-	-	8	2	-	20	20	-	-	50	3	50	70		
3.6	Workshop Technology	4	-	6	5	20	10	30	50	2 ½	20	4	70	100		
#Student Centred Activities (SCA)		-	-	3	1	-	30	30	-	-	-	-	-	30		
Total		22	2	24	27	100	90	190	250	-	130	-	380	570		

* Common with other diploma programmes

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

FOURTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
4.1	*Communication Skill-II	4	-	2	4	20	10	30	50	2 ½	20	3	70	100	
4.2	Refrigeration and Air Conditioning	5	1	2	6	20	10	30	50	2 ½	20	3	70	100	
4.3	Hydraulics and Pneumatics	5	1	2	6	20	10	30	50	2 ½	20	3	70	100	
4.4	Computer Aided Design and Manufacturing	4	-	6	6	20	10	30	50	2 ½	20	3	70	100	
4.5	*Environmental Studies	3	-	2	3	20	10	30	50	2 ½	20	3	70	100	
4.6	*Energy Conservation	3	-	2	3	20	10	30	50	2 ½	20	3	70	100	
4.7	Universal Human Values	2	-	1	1	-	20	20	-	-	30	3	30	50	
#Student Centred Activities (SCA)		-	-	3	1	-	30	30	-	-	-	-	-	30	
Total		26	2	20	30	120	110	230	300	-	150	-	450	680	

* Common with other diploma programme

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc. Industrial training of 4 weeks duration to be organised after 4th semester exams

FIFTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME									Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT						
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot		
	Industrial Training (4 Weeks)	-	-	-	2	-	-	-	-	-	50	-	50	50	
5.1	*Industrial Management and Entrepreneurship Development	5	-	-	4	20	-	20	50	2 ½	-	-	50	70	
5.2	Theory of Machines	5	2	-	6	20	-	20	50	2 ½	-	-	50	70	
5.3	Machine Design	5	2	-	6	20	-	20	50	2 ½	-	-	50	70	
5.4	Production Technology	6	-	8	7	20	20	40	50	2 ½	50	4	100	140	
5.5	Production Management	4	-	2	4	20	10	30	50	2 ½	20	3	70	100	
5.6	Automobile Engineering	4	-	4	4	20	10	20	50	2 ½	20	3	70	100	
	#Student Centred Activities (SCA)	-	-	1	1	-	30	30	-	-	-	-	-	30	
	Total	29	4	15	34	120	70	190	300	-	140	-	440	630	

* Common with other diploma programme

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

SIXTH SEMESTER

Sr. No.	SUBJECTS	STUDY SCHEME Periods/Week			Credits	MARKS IN EVALUATION SCHEME								Total Marks of Internal & External
		L	T	P		INTERNAL ASSESSMENT			EXTERNAL ASSESSMENT					
						Th	Pr	Tot	Th	Hrs	Pr	Hrs	Tot	
6.1	Industrial Engineering	6	-	2	6	20	10	30	50	2 ½	20	3	70	100
6.2	Metrology and Measuring Instruments	5	-	4	7	20	10	30	50	2 ½	20	3	70	100
6.3	CNC Machines and Automation	4	-	4	5	20	10	30	50	2 ½	20	3	70	100
6.4	** Elective	5	-	-	6	20	-	20	50	2 ½	-	-	50	70
6.5	Project Work	-	-	12	4	-	40	40	-	-	60	3	60	100
#Student Centred Activities (SCA)		-	-	6	1	-	30	30	-	-	-	-	-	30
Total		20	-	28	29	80	100	180	200	-	120	-	320	500

- ** Any one out of the following:-
 6.4.1. Repair and Maintenance
 6.4.2. Tool Engineering

Student Centred Activities will comprise of co-curricular activities like extension lectures, self study, games, hobby clubs e.g. photography etc., seminars, declamation contests, educational field visits, N.C.C., NSS, Cultural Activities, disaster management and safety etc.

8. GUIDELINES FOR ASSESSMENT OF STUDENT CENTRED ACTIVITIES (SCA)

It was discussed and decided that the maximum marks for SCA should be 30 as it involves a lot of subjectivity in the evaluation. The marks may be distributed as follows:

- i. 10 Marks for general behavior and discipline
(by HODs in consultation with all the teachers of the department)
- ii. 5 Marks for attendance as per following:
(by HODs in consultation with all the teachers of the department)
 - a) 75 - 80% 2 Marks
 - b) 80 - 85% 4 Marks
 - c) Above 85% 5 Marks
- iii. 15 Marks maximum for Sports/NCC/Cultural/Co-curricular/ NSS activities as per following:
(by In-charge Sports/NCC/Cultural/Co-curricular/NSS)
 - a) 15 - State/National Level participation
 - b) 10 - Participation in two of above activities
 - c) 5 - Inter-Polytechnic level participation

Note: There should be no marks for attendance in the internal sessional of different subjects.

3.1 APPLIED MATHEMATICS –III

L	T	P
5	-	-

RATIONALE

Contents of this course provide understanding of some elementary and advanced mathematics algorithms and their applications of solving engineering problems. Content of this course will enable students to use some advanced techniques like Beta-Gamma function, Fourier series, Laplace transform and probability distributions in solving complex engineering problems.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- understand matrix operations and uses of matrix in different problems.
- apply elementary row and column operations in finding inverse of a matrix.
- find Eigen values, Eigen vectors of a matrix and their different properties.
- understand degree/order of differential equations and their solution techniques.
- use differential equations in engineering problems of different areas.
- find Fourier series expansion of a function
- apply Laplace transform and their applications in solving engineering problems.
- understand concept of probability distribution and their applications.

DETAILED CONTENTS

1. Matrices

(16 Periods)

1.1 Algebra of Matrices

Addition, Multiplication of matrices, Null matrix and a unit matrix, Square matrix, Symmetric, Skew symmetric, Hermitian, Skew hermitian, Orthogonal, Unitary, diagonal and Triangular matrix, Determinant of a matrix.

Definition and Computation of inverse of a matrix.

1.2 Elementary Row/Column Transformation

Meaning and use in computing inverse and rank of a matrix.

1.3 Linear Dependence

Linear dependence/independence of vectors, Definition and computation of rank of matrix. Computing rank through determinants, Elementary row transformation and through the concept of a set of independent vectors, Consistency of equations.

1.4 Eigen Pairs

Definition and evaluation of eigen values and eigen vectors of a matrix of order two and three, Cayley-Hamilton theorem (without Proof) and its verification, Use in finding inverse and powers of a matrix.

2. Differential Calculus (15 Periods)
 - 2.1 Function of two variables, identification of surfaces in space, conicoids
 - 2.2 Partial Differentiation :
Directional derivative, Gradient, Use of gradient f , Partial derivatives, Chain rule, Higher order derivatives, Euler's theorem for homogeneous functions, Jacobians.
 - 2.3 Vector Calculus :
Vector function, Introduction to double and triple integral, differentiation and integration of vector functions, gradient, divergence and curl, differential derivatives.

3. Differential Equation (15 Periods)
 - 3.1 Formation, Order, Degree, Types, Solution :
Formation of differential equations through physical, geometrical, mechanical and electrical considerations, Order, Degree of a differential equation, Linear, nonlinear equation.
 - 3.2 First Order Equations :
Variable separable, equations reducible to separable forms, Homogeneous equations, equations reducible to homogeneous forms, Linear and Bernoulli form exact equation and their solutions.
 - 3.3 Higher Order Linear Equation :
Property of solution, Linear differential equation with constant coefficients (PI for $X = e^{ax}$, $\sin ax$, $\cos ax$, X^n , $e^{ax}V$, XV)
 - 3.4 Simple Applications
LCR circuit, Motion under gravity, Newton's law of cooling, radioactive decay, Population growth, Force vibration of a mass point attached to spring with and without damping effect. Equivalence of electrical and mechanical system

4. Integral Calculus (12 Periods)
 - 4.1 Beta and Gamma Functions :
Definition, Use, Relation between the two, their use in evaluating integrals.
 - 4.2 Fourier Series :
Fourier series of $f(x)$, $-n < x < n$, Odd and even function, Half range series.

- 4.3 Laplace Transform :
Definition, Basic theorem and properties, Unit step and Periodic functions, inverse laplace transform, Solution of ordinary differential equations
5. Probability and Statistics (12 Periods)
- 5.1 Probability :
Introduction, Addition and Multiplication theorem and simple problem.
- 5.2 Distribution :
Discrete and continuous distribution, Binomial Distribution, Poisson Distribution, Normal Distribution..

INSTRUCTIONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples. The basic elements of Laplace transform, differential equations and applications of differential equations can be taught with engineering applications of relevant branch.

MEANS OF ASSESSMENT

- Assignments and Quiz/Class Tests
- Mid-term and End-term Written Tests
- Model/Prototype Making

RECOMMENDED BOOKS

1. Elementary Engineering Mathematics by BS Grewal, Khanna Publishers, New Delhi
2. Engineering Mathematics, Vol I & II by SS Sastry, Prentice Hall of India Pvt. Ltd.,
3. Applied Mathematics-III by Chauhan and Chauhan, Krishna Publications, Meerut.
4. Applied Mathematics-II by Kailash Sinha and Varun Kumar; Aarti Publication, Meerut.
5. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

SUGGESTED DISTRIBUTION OF MARKS

Topic	Time Allotted (Periods)	Marks Allotted (%)
1.	16	24
2.	15	20
3.	15	20
4	12	18
5	12	18
Total	70	100

3.2 ENGINEERING MATERIALS

L T P
4 - 2

RATIONALE

Lot of development has taken place in the field of materials. New materials are being developed and it has become possible to change the properties of materials to suit the requirements. Diploma holders in this course are required to make use of different materials for various applications. For this purpose, it is necessary to teach them basics of metal structure, properties, usage and testing of various ferrous and non ferrous materials and various heat treatment processes. This subject aims at developing knowledge about the characteristics, testing and usage of various types of materials used in industries.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- distinguish between metals and non metals and ferrous and non ferrous materials.
- explain the arrangement of atoms in various crystals.
- carry out various heat treatment processes.
- analyze microstructure and changes in microstructure due to heat treatment.
- classify various types of plastics and rubber.
- explain properties and applications of composites, ceramics and smart materials.
- select suitable material to be used for various engineering applications.
- perform destructive and non-destructive testing of materials.

DETAILED CONTENTS

1. Introduction (06 Periods)

Material, History of Material Origin, Scope of Material Science, Overview of different engineering materials and applications, Classification of materials, Thermal, Chemical, Electrical, Mechanical properties of various materials, Present and future needs of materials, Overview of Biomaterials and semi-conducting materials, Various issues of Material Usage-Economical, Environment and Social.

2. Crystallography (08 Periods)

Fundamentals: Crystal, Unit Cell, Space Lattice, Arrangement of atoms in Simple Cubic Crystals, BCC, FCC and HCP Crystals, Number of atoms per unit Cell, Atomic Packing Factor.

Deformation: Overview of deformation behavior and its mechanism, behavior of material under load control and strain control.

Failure Mechanisms: Overview of failure modes, fracture, fatigue and creep.

3. Metals And Alloys (12 Periods)

Ferrous Materials: Different iron ores, Raw materials in production of iron and steel, Basic process of iron-making and steel-making, Classification of iron and steel.

Cast Iron: Different types of Cast Iron, manufacture and their use. Classification of Grey cast iron and S.G. iron

Steels: Steels and alloy steel, Classification of plain carbon steels, Properties and usage of different types of Plain Carbon Steels, Effect of various alloys on properties of steel, Uses of alloy steels (high speed steel, stainless steel, spring steel, silicon steel)

Non Ferrous Materials: Properties and uses of Aluminum, Copper and Zinc and their alloys

4. Heat Treatment (06 Periods)

Purpose of heat treatment, Solid solutions and its types, Formation and decomposition of Austenite, Martensitic Transformation – Simplified Transformation Cooling Curves. Various heat treatment processes- hardening, tempering, annealing, normalizing, Case hardening and surface hardening, Hardenability of steels, Selection of case carburizing and induction hardening steels. Types of heat treatment furnaces (only basic idea)

5. Plastics (06 Periods)

Important sources of plastics, Classification-thermoplastic and thermoset and their uses, Various trade names of plastics, Plastic coatings, food grade plastics. Applications of plastics in automobile and domestic use.
Rubber classification - Natural and synthetic. Selection of rubber

6. Advanced Materials (06 Periods)

Composites-Classification, properties, applications
Ceramics-Classification, properties, applications
Adhesives – Classification, properties and applications
Smart materials - properties and applications.

7. Miscellaneous Materials (06 Periods)

Overview of -Tool and Die materials, Materials for bearing metals, Materials for Nuclear Energy, Refractory materials.

8. Identification and Testing of Materials (Destructive and NDT) (06 Periods)

Identification of metal by giving mini projects.

Destructive testing: Stress testing, Harness testing

Non-destructive testing: Eddy-current, Magnetic-particle, Liquid penetration, radiographic, Ultrasonic and visual testing

LIST OF PRACTICALS

1. Use of diamond polishing apparatus.
2. To perform following heat treatment process on materials of known carbon percentage and checking the change in the properties
 - a) Annealing
 - b) Normalising
 - c) Case hardening
3. Preparation of specimens and study of micro structure of given metals and alloys on metallurgical microscope
 - a) Brass
 - b) Bronze
 - c) Grey Cast Iron
 - d) Low Carbon Steel
 - e) High Carbon Steel
 - f) High Speed Steel
4. To prepare specimen for microscope examination for polishing
5. To determine composition of alloy steel by steeloscope

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

INSTRUCTIONAL STRATEGY

While imparting instructions, teacher should show various types of engineering materials to the students. Students should be asked to collect samples of various materials available in the market. Visits to industry should be planned to demonstrate use of various types of materials or Heat Treatment Processes in the industry.

RECOMMENDED BOOKS

1. Text book of Material Science by R.K. Rajput; Katson Pubs, Ludhiana
2. Text book of Material Science by V.K. Manchanda; India Publishing House, Jalandhar.
3. Introduction to Material Science by A.R. Gupta, Satya Prakashan, New Delhi.
4. Material Science by Hazra, Chaudhary
5. Material Science and Engineering Raghuan by Raghvaan PHI
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh

Website for Reference

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1.	06	10
2.	08	16
3.	12	22
4.	06	12
5.	06	10
6.	06	10
7.	06	10
8.	06	10
Total	56	100

3.3 MECHANICS OF SOLIDS

L T P

4 1 2

RATIONALE

Diploma holders in this course are required to analyze reasons for failure of different components and select the required material for different applications. For this purpose, it is essential to teach them concepts, principles, applications and practices covering stress, strain, bending moment, shearing force, shafts and columns. It is expected that efforts will be made to provide appropriate learning experiences in the use of basic principles in the solution of applied problems to develop the required competencies.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- interpret various concepts and terms related to strength of materials
- calculate stresses in bars of various cross-section.
- calculate energy stored by materials subjected to axial loads.
- calculate moment of inertia of different sections.
- interpret the concept of bending and torsion and calculate stresses on different section of materials.
- draw and calculate shear force and bending moment diagrams of beam under given loading
- calculate stresses in thin cylindrical shells.
- determine the diameter of a shaft under combined bending and torsion.
- calculate critical axial loads on column under different end constraints.

DETAILED CONTENTS

- | | | |
|----|---|--------------|
| 1. | Stresses and Strains | (08 Periods) |
| | 1.1. Basic assumptions; Concept of load, stress and strain | |
| | 1.2. Tensile compressive and shear stresses and strains | |
| | 1.3. Concept of Elasticity, Elastic limit and limit of proportionality. | |
| | 1.3.1. Nominal and true stress-strain diagrams. | |
| | 1.3.2. Hook's Law | |
| | 1.3.3. Young Modulus of elasticity | |
| | 1.3.4. Nominal stress | |
| | 1.3.5. Yield point, plastic stage | |
| | 1.3.6. Ultimate strength and breaking stress | |

- 1.3.7. Percentage elongation
 - 1.3.8. Proof stress and working stress
 - 1.3.9. Factor of safety
 - 1.3.10 Poisson's Ratio
 - 1.3.11 Shear modulus
 - 1.3.12 Deflection and stiffness
 - 1.4. Concepts of fatigue, creep and stress concentration
 - 1.5. Thermal stresses
2. Resilience (04 Periods)
- 2.1 Resilience, proof resilience and modulus of resilience
 - 2.2 Strain energy due to direct stresses
 - 2.3 Stresses due to gradual, sudden and falling load.
3. Moment of Inertia (05 Periods)
- 3.1. Concept of moment of inertia and second moment of area
 - 3.2 Radius of gyration
 - 3.3 Theorem of perpendicular axis and parallel axis (without derivation)
 - 3.4 Second moment of area of common geometrical sections :Rectangle, Triangle, Circle (without derivation); Second moment of area for L,T and I section
 - 3.5 Section modulus
4. Bending Stresses (06 Periods)
- 4.1 Concept of Bending stresses
 - 4.2. Theory of simple bending
 - 4.3. Use of the equation $\sigma/y = M/I = E/R$
 - 4.4. Concept of moment of resistance
 - 4.5. Bending stress diagram
 - 4.6. Calculation of maximum bending stress in beams of rectangular, circular, and T section.
 - 4.7 Permissible bending stress Section modulus for rectangular, circular and symmetrical I section.
5. Torsion (06 Periods)
- 5.1. Concept of torsion- difference between torque and torsion.
 - 5.2. Use of torque equation for circular shaft
 - 5.3. Comparison between solid and hollow shaft with regard to their strength and weight.
 - 5.4. Power transmitted by shaft
 - 5.5 Concept of mean and maximum torque
 - 5.6 Concept of Principal stresses, principal planes and max. shear stress.
 - 5.7 Determination of shaft diameter under combined bending and torsion.

6. Shear Force and Bending Moment (10 Periods)
- 6.1 Concept of beam and form of loading
 - 6.2 Concept of end supports-Roller, hinged and fixed
 - 6.3 Concept of bending moment and shearing force
 - 6.4 S.F. and B.M. Diagram for cantilever and simply supported beams with and without overhang subjected to concentrated load and U.D.L.
7. Columns (05 Periods)
- 7.1. Concept of column, modes of failure
 - 7.2. Types of columns
 - 7.3. Buckling load, crushing load
 - 7.4. Slenderness ratio
 - 7.5. Factors effecting strength of a column
 - 7.6 End restraints
 - 7.7 Effective length
 - 7.8 Strength of column by Euler Formula without derivation
 - 7.9. Rankine Gourdan formula (without derivation)
8. Thin Cylinder and Spherical Shells (04 Periods)
- 8.1 Introduction to longitudinal stresses, circumferential or hoop stresses and radial stresses
 - 8.2 Longitudinal and circumferential stresses in thin cylinder
 - 8.3 Longitudinal and circumferential stresses in thin Spherical shells
9. Slope and Deflections of Beams: (08 Periods)
- 9.1 Definition of slope and deflection, sign convention. Circular bending. Calculation of maximum slope and deflection for the following standard cases by double integration or moment area method.
- a) Cantilever having point load at the free end
 - b) Cantilever having point load at any point of the span
 - c) Cantilever with uniformly distributed load over the entire span
 - d) Cantilever having U.D.L. over part of the span from free end
 - e) Cantilever having U.D.L. over a part of span from fixed end
 - f) Simply supported beam with point load at centre of the span.
 - g) Simply supported beam with U.D. L. over entire span.

Note: All examples will be for constant moment of inertia without derivation of formula.

LIST OF PRACTICALS

1. To find the shear force at a given section of simply supported beam for different loading.

2. To find the value of 'E' for a steel beam by method of deflection for different loads.
3. To determine the Max-Fiber stress in X-section of simply supported beam with concentrated loads and to find the neutral axis of the section.
4. To determine the ultimate tensile strength, its modulus of Elasticity, stress at yield point, Elongation and contraction in X-sectional area of the specimen by U.T.M. through necking phenomenon.
5. To determine the ultimate crushing strength of materials like steel and copper and compare their strength.
6. To determine Rockwell Hardness No. and Brinell Hardness No. of a sample.
7. To estimate the Shock Resistance of different qualities of materials by Izod's test and Charpy test.
8. To determine the bending moment at a given section of a simply supported beam for different loading.
9. To determine the various parameters of helical coil spring.
10. To determine the angle of twist for a given torque by torsion apparatus and to plot a graph between torque and angle of twist.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

INSTRUCTIONAL STRATEGY

1. Expose the students to real life problems.
2. Plan assignments so as to promote problem solving abilities and develop continued learning skills.

RECOMMENDED BOOKS

1. SOM by Birinder Singh; Katson Publishing House, New Delhi.
2. SOM by RS Khurmi; S.Chand & Co; New Delhi
3. Mechanics of Materials by Dr. Kirpal Singh; Standard Publishers Distribution, New Delhi.
4. Elements of SOM by D.R. Malhotra and H.C.Gupta; Satya Prakashan, New Delhi.
5. Mechanics of Solids by Karmveer Saini, Krishna Publication House, Meerut.
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	12
2	04	08
3	05	08
4	06	12
5	06	10
6	10	16
7	05	10
8	04	08
9	08	16
Total	56	100

3.4 THERMAL ENGINEERING

L	T	P
5	1	3

RATIONALE

A diploma holder in this course is supposed to maintain steam generators, turbines, compressors and other power plant equipment. Therefore, it is essential to impart him basic concepts of thermodynamics, steam generators, steam turbines, compressors and about IC engines.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- apply thermodynamic laws.
- solve basic problems of gas equation using perfect gas laws.
- determine enthalpy, specific heat capacity and P-V-T surface of an ideal and real gas.
- explain the working, construction and applications of steam boilers and steam generators
- explain the functions and uses of air compressors.
- interpret different modes of heat transfer.
- explain the working of IC engine.
- assist in testing an IC engine.
- explain the functioning of steam turbine, gas turbine and jet propulsion.

DETAILED CONTENTS

1. Fundamental Concepts (06 Periods)
 Thermodynamic state and system, boundary, surrounding, universe, thermodynamic systems – closed, open, isolated, adiabatic, homogeneous and heterogeneous, macroscopic and microscopic, properties of system – intensive and extensive, thermodynamic equilibrium, quasi – static process, reversible and irreversible processes, Zeroth law of thermodynamics, definition of properties like pressure, volume, temperature, enthalpy, internal energy.
2. Laws of Perfect Gases (03 Periods)
 Definition of gases, explanation of perfect gas laws – Boyle’s law, Charle’s law, Avagadro’s law, Regnault’s law, Universal gas constant, Characteristic gas constants, derivation Specific heat at constant pressure, specific heat at constant volume of gas, simple problems on gas equation
3. Thermodynamic Processes on Gases (05 Periods)

Types of thermodynamic processes – isochoric, isobaric, isothermal, hyperbolic, isentropic, polytropic and throttling processes, equations representing the processes
Derivation of work done, change in internal energy, rate of heat transfer for the above processes

4. Laws of Thermodynamics (06 Periods)

Laws of conservation of energy, first law of thermodynamics (Joule's experiment), Application of first law of thermodynamics to non-flow systems – Constant volume, constant pressure, Adiabatic and polytropic processes.
Steady flow energy equation, Application of steady flow energy to equation, turbines, pump, boilers, nozzles.
Heat source and heat sinks, statement of second laws of thermodynamics: Kelvin Planck's statement, Clausius statement, Perpetual motion Machine of first kind, second kind, Carnot engine, Introduction of third law of thermodynamics, concept of irreversibility, entropy, ideal and real gases.

5. Properties of Steam (05 Periods)

Formation of steam and related terms, thermodynamics properties of steam, steam tables, internal latent heat, internal energy of steam, Mollier diagram (H – S Chart), Expansion of steam, Hyperbolic, reversible adiabatic and throttling processes
Quality of steam (dryness fraction),

6. Steam Generators (04 Periods)

Uses of steam, classification of boilers, comparison of fire tube and water tube boilers. Construction features of Lancashire boiler, Nestler boiler, Babcock & Wilcox Boiler. Introduction to modern boilers.

7. Air Standard Cycles (04 Periods)

Meaning of air standard cycle – its use, condition of reversibility of a cycle
Description of Carnot cycle, Otto cycle, Diesel cycle, simple problems on efficiency, calculation for different cycles
Reasons for highest efficiency of Carnot cycle over all other cycles working between same temperature limits

8. Air Compressors (05 Periods)

Functions of air compressor – uses of compressed air, type of air compressors

Single stage reciprocating air compressor, its construction and working, representation of processes involved on P – V diagram, calculation of work done.

Rotary compressors – types, descriptive treatment of centrifugal compressor, axial flow compressor, vane type compressor

9. Introduction to Heat Transfer (04 Periods)

Modes of heat transfer, Fourier's law, steady state conduction, composite structures, Natural and forced convection, thermal radiation

10. IC Engines (12 Periods)

Introduction, Working principle of two stroke and four stroke cycle, SI engines and CI engines, Otto cycle, diesel cycle and dual cycle, Location and functions of various parts of IC engines and materials used for them. Testing of IC

Engines: Engine power - indicated and brake power, Efficiency - mechanical, thermal. relative and volumetric, Methods of finding indicated and brake power, Morse test for petrol engine, Heat balance sheet, simple numerical problems, Concept of pollutants in SI and CI engines, pollution control, norms for two or four wheelers - EURO - 1, EURO – 2.

11. Steam Turbines and Steam Condensers (08 Periods)

Function and use of steam turbine, Steam nozzles - types and applications

Steam turbines - impulse, reaction, construction and working principle

Governing of steam turbines, Function of a steam condenser, elements of condensing plant, Classification - jet condenser, surface condenser, Cooling pond and cooling towers

12. Gas Turbines and Jet Propulsion (08 Periods)

Classification, open cycle gas turbine and closed cycle gas turbine, comparison of gas turbines with reciprocating IC engines, applications and limitations of gas turbine. Open cycle constant pressure gas turbines - general layout, PV and TS diagram and working of gas turbine.

Closed cycle gas turbines, PV and TS diagram and working.

Principle of operation of ram-jet engine and turbo jet engine - application of jet engines

LIST OF PRACTICALS

1. Demonstration of mountings and accessories on a boiler.
2. Demonstrate the working of air compressor.
3. Demonstration of heat transfer through conduction, convection and Radiation
4. Study of working of high pressure boiler
5. Study the working of Lancashire boiler and Nestler boiler

6. Dismantle an IC engine and note down the condition of various parts, removal and fitting of piston, rings, measuring of bore size, crank shaft ovality and assemble it.
7. Servicing of petrol injection system
8. Valve servicing, grinding, lapping and fitting mechanism and tappet adjustment.
9. Inspection of ignition system of a multi-cylinder engine stressing ignition timings, setting, fixing order and contact breaker; gap adjustment, spark plug cleaning.
10. Service of cooling & lubrication system of IC engine and note down the functioning/testing of various components.
11. Determination of BHP by dynamometer.
12. Morse test on multi-cylinder petrol engine.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Small projects
- Viva-voce

RECOMMENDED BOOKS

1. Engineering Thermodynamics by PK Nag; Tata McGraw Hill, Delhi.
2. Basic Engineering Thermodynamics by Roy Chaudhary; Tata McGraw Hill, Delhi.
3. Engineering Thermodynamics by CP Arora; Tata McGraw Hill, Delhi.
4. A Treatise on Heat Engineering by VP Vasandani and DS Kumar; Metropolitan Book Company.
5. Internal Commercial Engine by V. Ganeshan; Tata McGraw Hill, Education
6. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	06	08
2	03	04
3	05	08
4	06	08
5	05	08
6	04	06
7	04	06
8	05	08
9	04	06
10	12	16
11	08	12
12	08	10
Total	70	100

3.5 COMPUTER AIDED DRAFTING AND 3D MODELLING

L T P
- - 8

RATIONALE

Computer Aided Design plays a very important role in designing products with exact determines for manufacturing industries. Modellings helps to achieve the designed shape and size of products for the manufacturing sector. After studying this subject the students will be able to know Drafting, Designing and Modelling techniques which helps a manufacturer machines sound for better product development.

LEARNING OUTCOMES

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

- know the advantages of using CAD in comparison with conventional method.
- draw and interpret CAD drawings using drawing, editing and viewing in CAD software.
- create easy and complex solids and assemblies using various tools in Solid works software.
- can understand exploded views and assembled views

DETAILED CONTENTS

1. Introduction to AutoCAD commands (6 drawing sheets)
 - 1.1 Concept of AutoCAD, Tool bars in Auto CAD, coordinate system, snaps, Grid, and ortho mode (Absolute, Relative and Polar)
 - 1.2 Drawing commands – point, line, arc, circle, ellipse, parabola.
 - 1.3 Editing commands – scale, erase, copy, stretch, lengthen and explode.
 - 1.4 Dimensioning and placing text in drawing area
 - 1.5 Sectioning and hatching
 - 1.6 Inquiry for different parameters of drawing entity
 - 1.7 Create layers within a drawing
 - 1.8 Specifying Geometrical Dimensioning & Tolerancing (GD&T) parameters in drawing

2. Detail and assembly drawing of the following using AUTOCAD (4 sheets)
 - 2.1 Plummer Block
 - 2.2 Wall Bracket
 - 2.3 Stepped pulley, V-belt pulley
 - 2.4 Flanged coupling
 - 2.5 Machine tool Holder (Three views)
 - 2.6 Screw jack or knuckle joint
 - 2.7 Foot step bearing

3. Isometric Drawing by CAD using Auto CAD (one sheet)

ISO Commands, User Co-ordinate System, View points, Viewports Elevation, World Co-ordinate System X/Y/Z Filter

Drawings of following on computer:

- Cone
- Cylinder
- Isometric view of objects

4. Introduction to Solid works

Introduction to Sketcher: Sketch Entities, Sketch Tools, Blocks, Dimensioning

4.1 Part modeling (4 models)

Part Modeling Tools:-

- 4.1.1 Creating reference planes
- 4.1.2 Creating Extrude features, Creating Revolve, Creating Swept features-
- 4.1.3 Creating Loft features
- 4.1.4 Creating Reference - points, axis, coordinates
- 4.1.5 Creating curves
- 4.1.6 Creating Fillet features
- 4.1.7 Inserting Hole types
- 4.1.8 Creating Chamfer
- 4.1.9 Creating Shell
- 4.1.10 Creating Rib
- 4.1.11 Creating Pattern Advanced Modeling Tools
- 4.1.12 Inserting Fastening features,
- 4.1.13 Environment & Utilities - Working with views and manipulating views,

4.2 Assembly (4 models)

Assembly Modeling Tools:-

Introduction to Assembly Modeling & Approaches – Top down and Bottom up approach, Applying Standard Mates- Coincident, Parallel, Perpendicular, Tangent, Concentric, Lock, Distance, Angle. Applying Advanced Mates – Symmetric, Width, Path Mate, Linear/Linear Coupler, Limit Mate. Applying Mechanical Mates – Cam, Hinge, Gear, Rack Pinion, Screw, and Universal Joint. Manipulating Components - Replacing Components, Rotating Components, Move Components, Collision Detection, Physical Dynamics, Dynamic Clearance, Detecting Interference Creating Pattern - Assembly Pattern, Mirror, Creating Explode Views

1. Lathe tool past assembly
2. Shaper tool assembly
3. Valve assembly
4. Screw Jack

INSTRUCTIONAL STRATEGY

1. Teachers should show model or realia of the component/part whose drawing is to be made.

2. Emphasis should be given on cleanliness, dimensioning, & layout of sheet.
3. Teachers should ensure use of IS codes related to drawing.

RECOMMENDED BOOKS

1. Engineering Drawing with AutoCAD 2000 by T. Jeyapooran; Vikas Publishing House, Delhi.
2. AutoCAD for Engineering Drawing Made Easy by P. NageswaraRao; Tata McGraw Hill, New Delhi.
3. AutoCAD 2000 for you by UmeshShettigar and Abdul Khader; Janatha Publishers, Udupi.
4. Auto CAD 2000 by Ajit Singh, TMH, New Delhi.
5. Designing with Pro Engineer, Sham Tickoo by Dream Tech Publications, New Delhi.
6. Designing with CATIA, by Sham Tickoo, Dream Tech. Publications, New Delhi
7. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR

Website for Reference:

<http://swayam.gov.in>

3.6 WORKSHOP TECHNOLOGY

L T P
4 - 6

RATIOANELE

Diploma holders are responsible for supervising production processes to achieve production targets and for optimal utilization of resources. For this purpose, knowledge about various manufacturing processes is required to be imparted. Hence the subject of workshop technology.

LEARNING OUTCOMES

After undergoing the subject, students will be able to:

- Fabricate welding joints using gas welding arc welding, TIG and MIG welding of mild steel and stainless steel materials.
- Select suitable (most appropriate) process electrodes, various parameters of process for given job.
- Explain principle of operations of modern welding processes.
- Inspect various welding joints and castings.
- Prepare pattern for given job.
- Select material and type of patterns, cores.
- Prepare sand moulds manually and on machine.
- Select type of moulding sand, adhesives, compact, strength and parameters of sand for given job.
- Cast a mould.
- Identify a suitable furnace, alloying elements
- Carry out deburring of castings.
- Test the properties of moulding sand (permeability, Strength, refractoriness, adhesiveness, cohesiveness).

DETAILED CONTENTS

1. Welding (14 Periods)
 - 1.1 Welding Process
Principle of welding, Classification of welding processes, Advantages and limitations of welding, Industrial applications of welding, Welding positions and techniques, symbols. Safety precautions in welding.

- 1.2 Gas Welding
Principle of operation, Types of gas welding flames and their applications, Gas welding equipment - Gas welding torch, Oxy acetylene cutting torch, Blow pipe, Pressure regulators, Filler rods and fluxes
- 1.3 Arc Welding
Principle of operation, Arc welding machines and equipment, A.C. and D.C. arc welding, Effect of polarity, current regulation and voltage regulation, Electrodes: Classification, B.I.S. specification and selection, Flux for arc welding. Requirements of pre heating, post heating of electrodes and work piece. Welding defects and their testing methods.
- 1.4 Other Welding Processes
Resistance welding: Principle, advantages, limitations, working and applications of spot welding, seam welding, projection welding and percussion welding, Atomic hydrogen welding, Shielded metal arc welding, submerged arc welding, Welding distortion, welding defects, methods of controlling welding defects and inspection of welded joints. Welding defects and inspection.
- 1.5 Modern Welding Methods
Methods, Principle of operation, advantages, disadvantages and applications of, Tungsten inert gas (TIG) welding, other welding process, Metal inert gas (MIG) welding, Thermit welding, Electro slag welding, Electron beam welding, Ultrasonic welding, Laser beam welding, Robotic welding
2. Pattern Making (10 Periods)
Types of pattern, Pattern material, Pattern allowances, Pattern codes as per B.I.S., Introduction to cores, core boxes and core materials, Core making procedure, Core prints, positioning of cores
3. Moulding and Casting (14 Periods)
- 3.1 Moulding Sand
Properties of moulding sand, their impact and control of properties viz. permeability, refractoriness, adhesiveness, cohesiveness, strength, flow ability, collapsibility, Various types of moulding sand, Testing of moulding sand. Safety precautions in foundry.

- 3.2 Mould Making
Types of moulds, Step involved in making a mould, Molding boxes, hand tools used for mould making, Molding processes: Bench molding, floor molding, pit molding and machine molding, Molding machines squeeze machine, jolt squeeze machine and sand slinger.
- 3.3 Casting Processes
Charging a furnace, melting and pouring both ferrous and non ferrous metals, cleaning of castings, Principle, working and applications of Die casting: hot chamber and cold chamber, Investment and lost wax process, centrifugal casting.
- 3.4 Gating and Riser System
Elements of gating system, Pouring basin, sprue, runner, gates, Types of risers, location of risers, Directional solidification
- 3.5 Melting Furnaces
Construction and working of Pit furnace, Cupola furnace, Crucible furnace – tilting type, Electric furnace
- 3.6 Casting Defects
Different types of casting defects, Testing of defects: radiography, magnetic particle inspection and ultrasonic inspection.
4. Metal Farming Process (10 Periods)
- 4.1 Press Working- Types of presses, type of dies, selection of press die, die material. Press Operations-Shearing, piercing trimming, punching, notching, shaving, gearing, embossing, stamping.
- 4.2 Forging- Open die forging, closed die gorging, Press forging, upset forging, swaging, up setters, roll forging, Cold and hot forging.
- 4.3 Rolling- Elementary theory of rolling, Types of rolling mills, Thread rolling, roll passes, Rolling defects and remedies.
- 4.4 Extrusion and Drawing- Type of extrusion- Hot and Cold, Direct and indirect, pipe drawing, tube drawing, wire drawing.

5. Plastic Processing (08 Periods)
- 5.1 Industrial use of plastics, situation where used.
 - 5.2 Injection moulding-principle, working of injection moulding machine.
 - 5.3 Compression moulding-principle, and working of compression moulding machine.
 - 5.4 Potential and limitations in the use of plastics

LIST OF PRACTICALS

General introduction to hand tools used in foundry, welding and pattern making and smithy shop.

WELDING SHOP

- Job 1. Preparing gas welding joint in vertical/Horizontal position joining M.S. Plates
- Job 2. Exercise on gas cutting of mild steel plate with oxy-acetylene gas torch.
- Job 3. Exercise on gas welding of cast iron and brass part or component.
- Job 4. Exercise on preparation of T Joint by arc welding
- Job 5. Exercise on spot welding/seam welding
- Job 6. Exercise on MIG and TIG welding
- Job 7. Exercise on arc welding pipe joint MS.

PATTERN MAKING

- Job 1. Preparation of solid/single piece pattern.
- Job 2. Preparation of two piece/split pattern
- Job 3. Preparation of a pattern on wooden lathe
- Job 4. Preparation of a self cored pattern
- Job 5. Preparation of a core box.

FOUNDRY SHOP

- Job 1. Preparation of mould with solid pattern on floor.
- Job 2. Preparation of floor mould of solid pattern using cope.
- Job 3. Preparation of floor mould of split pattern in cope and drag of moulding box.
- Job 4. Moulding and casting of a solid pattern of aluminum
- Job 5. Preparing a mould of step pulley and also preparing core for the same.
- Job 6. A visit to cast iron foundry should be arranged to have firsthand knowledge of cast iron melting pouring and casting.
- Job 7. Testing of moisture contents and strength of moulding sand.

FORGING SHOP/FITTING SHOP/SHEET METAL SHOP

- Job 1. Preparation of single ended spanner by hand/machine forging.
- Job 2. Preparation of simple die
- Job 3. Demonstration of spinning process on lathe and spinning a bowl on a lathe machine.
- Job 4. Demonstration of grinding process on lathe machine and grinding a job on a lathe machine
- Job 5. Preparation of utility item out of G.I. sheet.
- Job 6. Preparation of drilling Jig.

INSTRUCTIONAL STRATEGY

1. Teachers should lay special emphasis in making the students conversant with concepts, principles, procedures and practices related to various manufacturing processes.
2. Focus should be laid in preparing jobs using various machines/equipment in the workshop.
3. Use of audio-visual aids/video films should be made to show specialized operations.
4. Foreman Instructor should conduct classes of each Workshop explaining use of tools, jobs to be made and safety precautions related to each workshop prior to students being exposed to actual practicals.

RECOMMENDED BOOKS

1. Workshop Technology by BS Raghuvanshi : Dhanpat Rai and Sons Delhi
2. Elements of Workshop Technology by SK Choudhry and Hajra : Asia Publishing House
3. Welding Engineering by RL Aggarwal and T Manghnani; Khanna Publishers, Delhi
4. A Text Book of Production Engineering by PC Sharma; S Chand and Company Ltd. Delhi
5. Foundry Technology by KP Sinha and DB Goel; Roorkee Publishing House, Roorkee.
6. A Text Book of Manufacturing Science and Technology by A Manna, Prentice Hall of India, Delhi.

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	14	25
2	10	20
3	14	25
4	10	20
5	08	10
Total	100	100

4.1 COMMUNICATION SKILLS – II

L T P
4 - 2

RATIONALE

Knowledge of English Language plays an important role in career development. This subject aims at introducing basic concepts of communication besides laying emphasis on developing listening, speaking, reading and writing skills as parts of Communication Skill.

LEARNING OUTCOMES

After undergoing the subject, the students will be able to:

- Frame correct sentences with illustrations
- Comprehend the language correctly
- Interpret the language correctly
- Use given material in new situations.
- Correspond effectively using various types of writings like letters, memos etc.
- Communicate effectively in English with appropriate body language making use of correct and appropriate vocabulary and grammar in an organised set up and social context.

DETAILED CONTENTS

1. Functional Grammar (16 periods)
 - 1.1 Prepositions
 - 1.2 Framing Questions
 - 1.3 Conjunctions
 - 1.4 Tenses

- 2 Reading (16 periods)
 - 2.1 Unseen Passage for Comprehension (Vocabulary enhancement - Prefixes, Suffixes, one word substitution, Synonym and Antonym) based upon the passage should be covered under this topic.

- 3 Writing Skill (24 periods)
 - 3.1. Correspondence
 - a) Business Letters- Floating Quotations, Placing Orders, Complaint Letters.

- b) Official Letters- Letters to Government and other Offices
- 3.2. Memos, Circular, Office Orders
- 3.3. Agenda & Minutes of Meeting
- 3.4. Report Writing

LIST OF PRACTICALS

Note: Teaching Learning Process should be focused on the use of the language in writing reports and making presentations.

Topics such as Effective listening, effective note taking, group discussions and regular presentations by the students need to be taught in a project oriented manner where the learning happens as a byproduct.

Speaking and Listening Skills

1. Debate
2. Telephonic Conversation: general etiquette for making and receiving calls
3. Offering- Responding to offers.
4. Requesting – Responding to requests
5. Congratulating
6. Exploring sympathy and condolences
7. Asking Questions- Polite Responses
8. Apologizing, forgiving
9. Complaining
10. Warning
11. Asking and giving information
12. Getting and giving permission
13. Asking for and giving opinions

INSTRUCTIONAL STRATEGY

Students should be encouraged to participate in role play and other student-centered activities in class rooms and actively participate in listening exercises

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-semester and end-semester written tests
- Actual practical work, exercises and viva-voce
- Presentation and viva-voce

RECOMMENDED BOOKS

1. Communicating Effectively in English, Book-I by RevathiSrinivas; Abhishek Publications, Chandigarh.
2. Communication Techniques and Skills by R. K. Chadha; Dhanpat Rai Publications, New Delhi.
3. High School English Grammar and Composition by Wren & Martin; S. Chand & Company Ltd., Delhi.
4. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

1. [http://www.mindtools.com/ page 8.html](http://www.mindtools.com/page 8.html) – 99k
2. <http://www.letstalk.com.in>
3. <http://www.englishlearning.com>
4. <http://learnenglish.britishcouncil.org/en/>
5. <http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	16	28
2	16	28
3	24	44
Total	56	100

4.2 REFRIGERATION AND AIR CONDITIONING

L	T	P
5	1	2

RATIONALE

The diploma holders in Mechanical Engineering are responsible for supervising and maintenance of RAC system. For this purpose, the knowledge and skill covering basic principles of refrigeration and air conditioning is required to be imparted to the students. Moreover, RAC industry is expanding and employment opportunities in this field are good.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- explain the working and construction features of refrigeration and air conditioning systems
- draw and interpret various refrigeration cycles.
- make basic calculation of psychometric properties and processes.
- calculate heating and cooling load requirements of a room.
- explain latest developments in the field of refrigeration and air conditioning.
- calculate the properties of air by using psychometric chart.
- detect faults in an air-conditioner/refrigerator.
- carry out charging of air conditioner.

DETAILED CONTENTS

REFRIGERATION

1. Fundamentals of Refrigeration (07 Periods)

Introduction to refrigeration, air conditioning, necessity of refrigeration meaning of refrigerating effect, units of refrigeration, COP, difference between COP and efficiency, methods of refrigeration, Reversed carnot cycle and its representation on P-V and T-S diagram. Major application areas of refrigeration and air conditioning.

2. Vapour Compression System (10 Periods)

Introduction, principle, function, parts and necessity of vapour compression system, T- S and p- h charts, dry, wet and superheated compression. Effect of sub cooling, super heating, mass flow rate, entropy, enthalpy, work done, Refrigerating effect and COP. actual vapour compression system

3. Refrigerants (07 Periods)

Functions, classification of refrigerants, Nomenclature of refrigerant, Desirable properties of refrigerant, selection of refrigerant

4. Air Refrigeration System (08 Periods)

Introduction, advantages and disadvantages of air-refrigeration system over vapour compression system, bell – Collemann cycle, Boot strap system, calculation of mass flow rate, work done and COP

5. Vapour Absorption System (08 Periods)

Introduction, principle and working of simple absorption system and domestic electrolux refrigeration systems. Solar power refrigeration system, advantages and disadvantages of solar power refrigeration system over vapour compression system.,

6. Refrigeration Equipment (08 Periods)

6.1 Compressors- Function, various types of compressors

6.2 Condensers - Function, various types of condensers

6.3 Evaporators- Function, types of evaporators

6.4 Expansion Valves - Function, various types such as capillary tube, thermostatic expansion valve, low side and high side float valves, application of various expansion valves

6.5. Safety Devices-Thermostat, overload protector LP, HP cut out switch.

AIR CONDITIONING

7. Psychrometry (08 Periods)

Definition, importance, specific humidity, relative humidity, degree of saturation, DBT, WBT, DPT, sensible heat, latent heat, Total enthalpy of air.

8. Applied Psychrometry and Heat Load Estimation. (08 Periods)

Psychrometric chart, sensible heating and cooling, Adiabatic cooling, Humidification and dehumidification, cooling and humidification, cooling and dehumidification, heating and humidification, heating and dehumidification, by pass factor, room sensible heat factor, effective room sensible heat factor, grand sensible heat factor, ADP, room DPT. Heating and cooling load calculation.

Heating and humidification, cooling and dehumidification, window air-conditioning, split type air-conditioning, car air-conditioning, central air-conditioning.

9. Latest development in refrigeration and air conditioning:- (06 Periods)

Inverter technology, auto-defrosting, blast cooling, star rating.

LIST OF PRACTICALS

1. Demonstration of various refrigeration tools and equipment.
2. Practice in cutting, bending, flaring, swaging and brazing of tubes.
3. Study of thermostatic switch, LP/HP cut out overload protector filters, strainers and filter driers.
4. Identify various parts of a refrigerator and window air conditioner.
5. To find COP of Refrigeration system
6. To measure air flow using anemometer.
7. Charging of a refrigerator/ air conditioner.
8. To detect faults in a refrigerator/ air conditioner
9. Visit to an ice plant or cold storage plant. or central air conditioning plant.
10. Demonstration and working of window type air-conditioner.
11. Demonstration and working of split type air-conditioner.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests
- Actual Practical Performance
- Report Writing
- Viva-voce

INSTRUCTIONAL STRATEGY

1. Teachers should take the students to industry and explain the details of refrigeration and air-conditioning systems and their components.
2. While imparting instructions, focus should be on conceptual understanding.
3. Training slides of “Carrier Fundamentals of Refrigeration Air Conditioning” to be shown to students.

RECOMMENDED BOOKS

8. Refrigeration and Air Conditioning by Domkundwar; Dhanpat Rai and Sons, Delhi.
9. Refrigeration and Air Conditioning by CP Arora; Tata McGraw Hill, New Delhi.
10. Refrigeration and Air Conditioning by R.S Khurmi and J.K. Gupta; S Chand and Company Limited, New Delhi.
11. Refrigeration and Air Conditioning by Dr.Harjeev Khanna; Dhanpat Rai and Sons, Delhi.

12. Refrigeration and Air Conditioning by Dr. R.K Rajput; S.K. Kataria and Sons, Ludhiana.
 13. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (periods)	Marks Allotted (%)
1	07	09
2	10	14
3	07	09
4	08	12
5	08	12
6	08	12
7	08	12
8	08	12
9	06	08
Total	70	100

4.3 HYDRAULICS AND PNEUMATICS

L	T	P
5	1	2

RATIONALE

Diploma holders in this course are required to deal with problems of fluid and use of hydraulics and pneumatics in power generation. For this purpose, knowledge and skills about fluid mechanics and machinery, hydraulics and pneumatics systems are required to be imparted for enabling them to perform above functions.

LEARNING OUTCOMES

After undergoing this course, the students will be able to:

- Explain fluid properties, their units and conversion.
- Measure different types of pressures.
- Maintain different types of pressure gauges.
- Calculate flow and discharge of various liquids.
- Apply Bernoulli's theorem for calculating pipe diameter and height of pipe from ground.
- Calculate pipe friction and losses in pipelines.
- Specify hydraulic machines for different applications.
- Apply Pascal's law in practical applications.
- Explain the functions of various components used in hydraulic and pneumatic system.
- Maintain hydraulic and pneumatic system.

DETAILED CONTENTS

1. Introduction (06 Periods)

Fluid, types of fluid; properties of fluid viz mass density, weight density (specific weight), specific volume, capillarity, specific gravity, viscosity, compressibility, surface tension, kinematic viscosity and dynamic viscosity and their units.

2. Pressure and its Measurement (07 Periods)

- 2.1 Concept of pressure (Atmospheric Pressure, gauge pressure, absolute pressure)
- 2.2 Pressure measuring devices: peizometer tube manometers - simple U-tube, differential single column, inverted U-tube, micromanometer including simple problems
- 2.3 Bourdon pressure gauge, Diaphragm pressure gauge, dead weight pressure gauge

3. Flow of Fluids (09 Periods)

Types of fluid flow – steady and unsteady, uniform and non-uniform, laminar and turbulent; rate of flow and their units; continuity equation of flow; potential energy of a flowing fluid; total head; Bernoulli's theorem (statement and proof) and its applications. Discharge measurement with the help of venturi-meter, orifice meter, pitot-tube, limitations of Bernoulli's theorem simple problems.

4. Flow through Pipes (10 Periods)

4.1 Definition of pipe flow, wetted perimeter, hydraulic mean depth, hydraulic gradient; loss of head due to friction; Chezy's equation and Darcy's equation of head loss (without proof), Reynold's number and its effect on pipe friction; siphon, power developed. Water hammer, anchor block, siphon, surge tank (concept only).

4.2 Loss of head in pipes due to sudden enlargement, sudden contraction, obstruction on flow path, change of direction and pipe fittings (without proof)

5. Hydraulic System (05 Periods)

Description, operation and application of hydraulic systems – hydraulic ram, hydraulic jack, hydraulic brake, hydraulic accumulator, hydraulic door closer, hydraulic press.

6. Water Turbines and Pumps (14 Periods)

6.1 Concept of a turbine, types of turbines – impulse and reaction type (concept only), difference between them. Construction and working of pelton wheel, Francis turbine, Propeller and Kaplan turbines. Unit speed, unit power, unit discharge, specific speed of turbines, Cavitations.

6.2 Concept of hydraulic pump, single acting reciprocating pump (construction and operation only), vane, screw and gear pumps.

6.3 Construction, working and operation of centrifugal pump. Performance, efficiencies and specifications of a centrifugal pump, pitting, cavitation, priming.

7. Introduction to Oil Power Hydraulics and Pneumatics (05 Periods)

7.1 Introduction to oil power hydraulic and pneumatic system

7.2 Statement of Pascal law and its applications

7.3 Industrial applications of oil power hydraulic and pneumatic system

8. Components of Hydraulic Systems (06 Periods)
- 8.1 Basic components of hydraulic system, function of each component in a hydraulic circuit.
 - 8.2 Oil reservoirs, couplings, motors and pumps – definition and functions of the parts,
 - 8.3 Filters- definition and purpose, classification
 - 8.4 Seals and packing- classification of seals, sealing materials.
9. Components of Pneumatic Systems (08 Periods)
- 9.1 Basic components – function of each component
 - 9.2 Air compressors - Introduction
 - 9.3 Air cylinder – types, function, single acting, double acting, rotating, non-rotating, piston type, diaphragm type, tandem cylinder, double ended cylinder, duplex cylinder.
 - 9.4 Air filter, regulator and lubricator – their necessity in pneumatic circuit.
 - 9.5 Installation, maintenance and application of air cylinders.

LIST OF PRACTICALS

1. Measurement of pressure head by employing.
 - i) Piezometer tube
 - ii) Single and double column manometer
2. To find out the value of coefficient of discharge for a venturimeter.
3. Measurement of flow by using venturimeter.
4. Verification of Bernoulli's theorem.
5. To find coefficient of friction for a pipe (Darcy's friction).
6. To study hydraulic circuit of an automobile brake and hydraulic ram.
7. Study the working of a Pelton wheel and Francis turbine.
8. To study a single stage centrifugal pump for constructional details and its operation to find out its normal head and discharge.
9. Direct operation of single and double acting cylinder.
10. Automatic operation of double acting cylinder in single cycle using limit switch.
11. Operation of double acting cylinder with quick exhaust valve.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching-learning
2. Expose students to real life problems
3. Plan assignments so as to promote problem solving abilities and develop continued

learning skills

RECOMMENDED BOOKS

1. Fluid Mechanics by KL Kumar; S Chand and Co Ltd., Ram Nagar, New Delhi.
2. Hydraulics and Fluid Mechanics Machine by RS Khurmi ;S.Chand& Co. Ltd., New Delhi.
3. Fluid Mechanics through Problems by RJ Garde; Wiley Eastern Ltd., New Delhi.
4. Fluid Mechanics by Dr AK Jain, Khanna Publishers, New Delhi.
5. Hydraulic and Pneumatic Control by K Shammuga Sundaram, S. Chand & Co. Ltd., New Delhi
6. Hydraulics and Hydraulic Machinery by Dr. Jagadish Lal; Metropolitan Book Company Ltd., Delhi.
7. Hydraulic and Pneumatic Power and Control Design, Performance and Application byYeaple, McGraw Hill, New York..
8. Pneumatic Controls by Festo Didactic; Bangalore.
9. Pneumatics Control: An Introduction to the Principles by Werner Deppert and Kurt Stoll; Vogel – Verlag.
10. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Website for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Hrs)	Marks Allotted (%)
1	06	08
2	07	10
3	09	12
4	10	15
5	05	08
6	14	20
7	05	07
8	06	08
9	08	12
Total	70	100

4.4 COMPUTER AIDED DESIGN AND MANUFACTURING

L T P
4 - 6

RATIONALE

Manufacturing of this century belongs to computerized equipment & machine tools to manufacture a variety of components with high quality, high precision & low cost at a faster rate. Computer Aided Designing, Computer Aided Manufacturing, & Flexible Manufacturing Systems-all are the part of Computer Integrated Manufacturing which help to achieve the desired goals in manufacturing. After studying the subject, the students will be able to know about these integrated techniques which help a manufacturer to achieve his goal with in stipulated time.

LEARNING OUTCOMES

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

- know about Computer aided design and manufacturing.
- know the process of 2D & 3D transformations
- know the method of viewing objects in 3D space.
- know about CNC operations for turning and milling.
- understand about tool path generation and verification.
- know about flexible manufacturing system.
- know about Rapid Prototype additive manufacturing
- know about robotics.

DETAILED CONTENTS

1. Introduction (08 periods)
 - 1.1 Introduction to CAD/CAM/CIM
 - 1.2 Advantages of CAD/CAM
 - 1.3 Product Cycle and CAD/CAM
 - 1.4 Automation and CAD/CAM
 - 1.5 Reasons for implementation of CAD/CAM
 - 1.6 Steps involved in CAM operation

2. Surface / Solid Modelling Using CAD/CAM (08 periods)
 - 2.1 Introduction to parametric and non-parametric surfaces
 - 2.2 Creation of simple surfaces using revolved surface, ruled surface and 3D surfaces commands
 - 2.3 Designing Software used in creation of solid models
 - 2.4 Concept of solid models
 - 2.5 Solid Primitives- Box, cylinder, Cone, Sphere, Wedge and torus
 - 2.6 Construction of solid using Region, Extrude and Revolved feature

- 2.7 Creation of Composite solid using Boolean function e.g. Union, Subtraction and Intersection.
 - 2.8 Sectioning of Solids and modification of solid Edges and faces using solid editing commands. Shell, Separate commands.
 - 2.9 Performing 3D operations like 3D array, mirror and rotate
 - 2.10 Creation of fillets and chamfers
 - 2.11 Dimensioning of solids
 - 2.12 2D and 3D transformation: Translation, Scaling, rotation, mirror, zooming, panning and clipping.
- 3. Viewing Objects in 3D Space (08 periods)**
- 3.1 Viewing the objects in different views.
 - 3.2 Concept of SW, SE, NE and Isometric Views.
 - 3.3 View Ports
 - 3.4 Layout, changing from Model to Paper space Layout
 - 3.5 Arranging the Drawing showing different views to get the hard copy
 - 3.6 Plotting the drawing
- 4. CAM (Computer Aided Manufacturing) (10 periods)**
- 4.1 Setting up the jobs, defining the operation, creating geometry
 - 4.2 Specifying the tools, machining parameters and type of machining
 - 4.3 Back plotting and verification of operation
 - 4.4 Post processing - Converting the generated tool path in NC code depending on the system
 - 4.5 Setting up the parameter relating to communication like transfer of programs to CNC machine
 - 4.6 Transfer of drawing data from any CAD software to CNC MIC and generation of G-codes, M-codes.
- 5. Flexible Manufacturing System (08 periods)**
- 5.1 Introduction to FMS.
 - 5.2 Principles of flexibility, changes in manufacturing system - external changes and internal changes job flexibility, machine flexibility.
 - 5.3 Features of FMS – production equipment, support system, material handling system, computer control system.
 - 5.4 Advantages & limitations of FMS.

6. Manufacturing Applications- Rapid Prototyping (06 periods)
- 6.1 3D printing
 - 6.2 Fused deposition modeling
 - 6.3 Laminated object manufacturing
 - 6.4 Selective laser sintering
 - 6.5 Stereo lithography
 - 6.6 Ball 3 to 2 particle manufacturing
7. Robotics (08 periods)
- 7.1 Introduction to robot
 - 7.2 Robot configuration
 - 7.3 Robot motions
 - 7.4 Robot programming languages
 - 7.5 Work cell, control and interlock, robot sensors
 - 7.6 Robot applications

LIST OF PRACTICALS

1. Performing 3D operations like Array, mirror, rotation, translation using solid works.
2. Performing 3D operation- panning, zooming, clipping etc.
3. CNC Programming for turning operation
4. CNC Programming for pocket milling
5. CNC Programming for profile milling
6. CNC Programming for facing and drilling
7. Performing operation on trainer Lathe
8. Designing of Simple machine components
9. Designing of Crank shaft (Connecting Rod)
10. Performing simple assembly operations like- nut, bolt, coupling etc.

INSTRUCTIONAL STRATEGY

1. Use computer based learning aids for effective teaching learning.
2. Students should be taken to various industrial units for clear conception of topics.
3. Efforts should be made to relate the process of teaching with direct experiences in the industry.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests
- Mid-term and end-term written tests,
- Model/prototype making
- Practical tasks

RECOMMENDED BOOKS

1. CAD/CAM by Mikell Groover and Zimmers; Prentice Hall of India Pvt. Ltd., Delhi.
2. Computer Aided Manufacturing by Rao, Kundra and Tiwari; Tata McGraw Hill, New Delhi.
3. Introduction to Robotics by John J. Craig; Pearson Education Asia, Singapore.
4. Industrial Robot by Groover; Prentice Hall of India Pvt. Ltd., Delhi.
5. Robotics by YoremKorem; McGraw Hill International. Book Co., New Delhi.
6. CAD/CAM – Theory and Practice by Zeid; Tata McGraw Hill Publishers, New Delhi.
7. CAD/CAM/CIM by S. Radha Krishan.
8. CNC Machines by Dr. B.S. Pabla – New Age Publications.
9. e-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	08	15
2	08	15
3	08	15
4	10	16
5	08	15
6	06	09
7	08	15
Total	56	100

4.5 ENVIRONMENTAL STUDIES

L T P
3 - 2

RATIONALE

A diploma holder must have knowledge of different types of pollution caused due to industries and constructional activities so that he may help in balancing the ecosystem and controlling pollution by various control measures. He should also be aware of environmental laws related to the control of pollution. He should know how to manage the waste. Energy conservation is the need of hour. He should know the concept of energy management and its conservation.

LEARNING OUTCOMES

After undergoing the subject, the student will be able to:

- Comprehend the importance of ecosystem and sustainable
- Demonstrate interdisciplinary nature of environmental issues
- Identify different types of environmental pollution and control measures.
- Take corrective measures for the abatement of pollution.
- Explain environmental legislation acts.
- Define energy management, energy conservation and energy efficiency
- Demonstrate positive attitude towards judicious use of energy and environmental protection
- Practice energy efficient techniques in day-to-day life and industrial processes.
- Adopt cleaner productive technologies
- Identify the role of non-conventional energy resources in environmental protection.
- Analyze the impact of human activities on the environment

DETAILED CONTENTS

1. Introduction (04 Periods)
 - 1.1 Basics of ecology, eco system- concept, and sustainable development, Resources renewable and non renewable.
2. Air Pollution (04 Periods)
 - 2.1 Source of air pollution. Effect of air pollution on human health, economy, plant, animals. Air pollution control methods.
3. Water Pollution (08 Periods)
 - 3.1 Impurities in water, Cause of water pollution, Source of water pollution. Effect of water pollution on human health, Concept of dissolved O₂, BOD, COD. Prevention of water pollution- Water treatment processes, Sewage treatment. Water quality standard.
4. Soil Pollution (06 Periods)

- 4.1 Sources of soil pollution
 - 4.2 Types of Solid waste- House hold, Hospital, From Agriculture, Biomedical, Animal and human, excreta, sediments and E-waste
 - 4.3 Effect of Solid waste
 - 4.4 Disposal of Solid Waste- Solid Waste Management
5. Noise pollution (06 Periods)
- Source of noise pollution, Unit of noise, Effect of noise pollution, Acceptable noise level, Different method of minimize noise pollution.
6. Environmental Legislation (08 Periods)
- Introduction to Water (Prevention and Control of Pollution) Act 1974, Introduction to Air (Prevention and Control of Pollution) Act 1981 and Environmental Protection Act 1986, Role and Function of State Pollution Control Board and National Green Tribunal (NGT), Environmental Impact Assessment (EIA).
7. Impact of Energy Usage on Environment (06 Periods)
- Global Warming, Green House Effect, Depletion of Ozone Layer, Acid Rain. Eco-friendly Material, Recycling of Material, Concept of Green Buildings.

LIST OF PRACTICALS

1. Determination of pH of drinking water
2. Determination of TDS in drinking water
3. Determination of TSS in drinking water
4. Determination of hardness in drinking water
5. Determination of oil & grease in drinking water
6. Determination of alkalinity in drinking water
7. Determination of acidity in drinking water
8. Determination of organic/inorganic solid in drinking water
9. Determination of pH of soil
10. Determination of N&P (Nitrogen & Phosphorus) of soil
11. To measure the noise level in classroom and industry.
12. To segregate the various types of solid waste in a locality.
13. To study the waste management plan of different solid waste
14. To study the effect of melting of floating ice in water due to global warming

INSTRUCTIONAL STRATEGY

In addition to theoretical instructions, different activities pertaining to Environmental Studies

like expert lectures, seminars, visits to green house, effluent treatment plant of any industry, rain water harvesting plant etc. may also be organized.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests

RECOMMENDED BOOKS

1. Environmental and Pollution Awareness by Sharma BR; Satya Prakashan, New Delhi.
2. Environmental Protection Law and Policy in India by Thakur Kailash; Deep and Deep Publications, New Delhi.
3. Environmental Pollution by Dr. RK Khitoliya; S Chand Publishing, New Delhi
4. Environmental Science by Deswal and Deswal; Dhanpat Rai and Co. (P) Ltd. Delhi.
5. Engineering Chemistry by Jain and Jain; Dhanpat Rai and Co. (P) Ltd. Delhi.
6. Environmental Studies by Erach Bharucha; University Press (India) Private Ltd., Hyderabad.
7. Environmental Engineering and Management by Suresh K Dhamija; S K Kataria and Sons, New Delhi.
8. E-books/e-tools/relevant software to be used as recommended by AICTE/UBTE/NITTTR, Chandigarh.

Websites for Reference:

<http://swayam.gov.in>

SUGGESTED DISTRIBUTION OF MARKS

Topic No.	Time Allotted (Periods)	Marks Allotted (%)
1	04	10
2	04	10
3	08	20
4	06	14
5	06	14
6	08	20
7	06	12
Total	42	100

4.6 ENERGY CONSERVATION

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RATIONALE

The requirement of energy has increased manifold in last two decades due to rapid urbanization and growth in industrial/service sector. It has become a challenging task to meet ever increasing energy demands with limited conventional fuels and natural resources. Due to fast depletion of fossil fuels and a tremendous gap between supply and demand of energy, it is essential to adopt energy conservation techniques in almost every field like industries, commercial and residential sectors etc. Energy conservation has attained priority as it is regarded as an additional energy resource. Energy saved is energy produced. This course covers the concepts of energy management and its conservation. It gives the insight to energy conservation opportunities in general industry and details out energy audit methodology and energy audit instruments.

LEARNING OUTCOMES

After undergoing this subject, the students will be able to:

- define principles and objectives of energy management and energy audit.
- understand Energy Conservation Act 2001 and its features.
- understand various forms & elements of energy.
- identify electrical and thermal utilities. Understand their basic principle of operation and assess performance of various equipments.
- identify areas of energy conservation and adopt conservation methods in various systems.
- evaluate the techno economic feasibility of the energy conservation technique adopted.

DETAILED CONTENTS

1. Basics of Energy
 - 1.1 Classification of energy- primary and secondary energy, commercial and non-commercial energy, non-renewable and renewable energy with special reference to solar energy, Capacity factor of solar and wind power generators.
 - 1.2 Global fuel reserve
 - 1.3 Energy scenario in India and state of U.P. Sector-wise energy consumption (domestic, industrial, agricultural and other sectors)
 - 1.4 Impact of energy usage on climate

2. Energy Conservation and EC Act 2001

- 2.1 Introduction to energy management, energy conservation, energy efficiency and its need
 - 2.2 Salient features of Energy Conservation Act 2001 & The Energy Conservation (Amendment) Act, 2010 and its importance. Prominent organizations at centre and state level responsible for its implementation.
 - 2.3 Standards and Labeling: Concept of star rating and its importance, Types of product available for star rating
3. Electrical Supply System and Motors
 - 3.1 Types of electrical supply system
 - 3.2 Single line diagram
 - 3.3 Losses in electrical power distribution system
 - 3.4 Understanding Electricity Bill: Transformers Tariff structure, Components of power (kW, kVA and kVAR) and power factor, improvement of power factor, Concept of sanctioned load, maximum demand, contract demand and monthly minimum charges (MMC)
 - 3.5 Transformers: Introduction, Losses in transformer, transformer Loading, Tips for energy savings in transformers
 - 3.6 Electric Motors
Types of motors, Losses in induction motors Features and characteristics of energy efficient motors, Estimation of motor loading, Variation in efficiency and power factor with loading, Tips for energy savings in motors
4. Energy Efficiency in Electrical Utilities
 - 4.1 Pumps: Introduction to pump and its applications, Efficient pumping system operation, Energy efficiency in agriculture pumps, Tips for energy saving in pumps
 - 4.2 Compressed Air System: Types of air compressor and its applications, Leakage test, Energy saving opportunities in compressors.
 - 4.3 Energy Conservation in HVAC and Refrigeration System: Introduction, Concept of Energy Efficiency Ratio (EER), Energy saving opportunities in Heating, Ventilation and Air Conditioning (HVAC) and Refrigeration Systems.
5. Lighting and DG Systems
 - 5.1 Lighting Systems: Basic definitions- Lux, lumen and efficacy, Types of different lamps and their features, Energy efficient practices in lighting
 - 5.2 DG Systems: Introduction, Energy efficiency opportunities in DG systems, Loading estimation

6. Energy Efficiency in Thermal Utilities

- 6.1 Thermal Basics: Thermal energy, Energy content in fuels, Energy Units and its conversions in terms of Metric Tonne of Oil Equivalent (MTOE)
- 6.2 Energy Conservation in boilers and furnaces : Introduction and types of boilers, Energy performance assessment of boilers, Concept of stoichiometric air and excess air for combustion, Energy conservation in boilers and furnaces, Do's and Don'ts for efficient use of boilers and furnaces
- 6.3 Cooling Towers: Basic concept of cooling towers, Tips for energy savings in cooling towers
- 6.4 Efficient Steam Utilization

7. Energy Conservation Building Code (ECBC)

- 7.1 ECBC and its salient features
- 7.2 Tips for energy savings in buildings: New Buildings, Existing Buildings

8. Waste Heat Recovery and Co-Generation

- 8.1 Concept, classification and benefits of waste heat recovery
- 8.2 Concept and types of co-generation system

9. General Energy Saving Tips

Energy saving tips in:

- 9.1 Lighting
- 9.2 Room Air Conditioner
- 9.3 Refrigerator
- 9.4 Water Heater
- 9.5 Computer
- 9.6 Fan, Heater, Blower and Washing Machine
- 9.7 Colour Television
- 9.8 Water Pump
- 9.9 Cooking
- 9.10 Transport

10. Energy Audit

- 10.1 Types and methodology
- 10.2 Energy audit instruments
- 10.3 Energy auditing reporting format

PRACTICAL EXERCISES

1. To conduct load survey and power consumption calculations of small building.
2. To check efficacy of different lamps by measuring power consumption and lumens using lux meter.
3. To measure energy efficiency ratio (EER) of an air conditioner.
4. To measure effect of valve throttling and variable frequency drive (VFD) on energy consumption by centrifugal pump.
5. To measure and calculate energy saving by arresting air leakages in compressor.
6. To measure the effect of blower speed on energy consumed by it.

STUDENT ACTIVITIES ON ENERGY CONSERVATION/ENERGY EFFICIENCY

- Presentations of Case Studies
- Debate competitions
- Poster competitions
- Industrial visits
- Visual Aids

INSTRUCTIONAL STRATEGY

Teachers are expected to lay considerable stress on understanding the basic concepts in energy conservation, principles and their applications. For this purpose, teachers are expected to give simple problems in the class room so as to develop necessary knowledge for comprehending the basic concepts and principles. As far as possible, the teaching of the subject must be supplemented by demonstrations and practical work in the laboratory. Visits to industries must be carried out. Expert from industry must be invited to deliver talks on energy conservation to students and faculty.

RECOMMENDED BOOKS

1. Guide book on General Aspects of Energy Management and Energy Audit by Bureau of Energy Efficiency, Government of India. Edition 2015
2. Guide book on Energy Efficiency in Electrical Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015
3. Guide book on Energy Efficiency in Thermal Utilities, by Bureau of Energy Efficiency, Government of India. Edition 2015

4. Handbook on Energy Audit & Environmental Management by Y P Abbi & Shashank Jain published by TERI. Latest Edition

Important Links:

- (i) Bureau of Energy Efficiency (BEE), Ministry of Power, Government of India. www.beeindia.gov.in.
- (ii) Ministry of New and Renewable Energy (MNRE), Government of India. www.mnre.gov.in.
- (iii) Uttar Pradesh New and Renewable Energy Agency (UPNEDA), Government of Uttar Pradesh. www.upneda.org.in.
- (iv) Central Pollution Control Board (CPCB), Ministry of Environment, Forest and Climate Change, Government of India. www.cpcb.nic.in.
- (v) Energy Efficiency Services Limited (EESL). www.eeslindia.org.
- (vi) Electrical India, Magazine on power and electrical products industry. www.electricalindia.in.

4.7 Universal Human Values

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Course Objectives

This introductory course input is intended

1. To help the students appreciate the essential complementarity between 'VALUES' and 'SKILLS' to ensure sustained happiness and prosperity, which are the core aspirations of all human beings
2. To facilitate the development of a Holistic perspective among students towards life and profession as well as towards happiness and prosperity based on a correct understanding of the Human reality and the rest of Existence. Such a holistic perspective forms the basis of Universal Human Values and movement towards value-based living in a natural way
3. To highlight plausible implications of such a Holistic understanding in terms of ethical human conduct, trustful and mutually fulfilling human behavior and mutually enriching interaction with Nature

Thus, this course is intended to provide a much needed orientational input in value education to the young enquiring minds.

Course Methodology

1. The methodology of this course is explorational and thus universally adaptable. It involves a systematic and rational study of the human being vis-à-vis the rest of existence.
2. It is free from any dogma or value prescriptions.
3. It is a process of self-investigation and self-exploration, and not of giving sermons. Whatever is found as truth or reality is stated as a proposal and the students are facilitated to verify it in their own right, based on their Natural Acceptance and subsequent Experiential Validation.
4. This process of self-exploration takes the form of a dialogue between the teacher and the students to begin with, and then to continue within the student leading to continuous self-evolution.
5. This self-exploration also enables them to critically evaluate their pre-conditionings and present beliefs.

The syllabus for the lectures is given below:

- After every two lectures of one hour each, there is one hour practice session.
- The assessment for this subject is as follows:
- Sessions Marks (Internal): 20
- Practical Marks (External): 30
- Total Marks: 50

UNIT 1: Course Introduction - Need, Basic Guidelines, Content and Process for Value Education

1. Understanding the need, basic guidelines, content and process for Value Education
2. Self-Exploration–what is it? - its content and process; ‘Natural Acceptance’ and Experiential Validation- as the mechanism for self-exploration
3. Continuous Happiness and Prosperity- A look at basic Human Aspirations

4. Right understanding, Relationship and Physical Facilities- the basic requirements for fulfillment of aspirations of every human being with their correct priority
5. Understanding Happiness and Prosperity correctly- A critical appraisal of the current scenario
6. Method to fulfill the above human aspirations: understanding and living in harmony at various levels

UNIT 2: Understanding Harmony in the Human Being - Harmony in Myself!

1. Understanding human being as a co-existence of the sentient 'I' and the material the Body'
2. Understanding the needs of Self ('I') and 'Body' - *Sukh* and *Suvidha*
3. Understanding the Body as an instrument of 'I' (I being the doer, seer and enjoyer)
4. Understanding the characteristics and activities of 'I' and harmony in 'I'
5. Understanding the harmony of I with the Body: *Sanyam* and *Swasthya*; correct appraisal of Physical needs, meaning of Prosperity in detail
6. Programs to ensure *Sanyam* and *Swasthya*
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 3: Understanding Harmony in the Family and Society- Harmony in Human-Human Relationship

1. *Understanding Harmony in the family – the basic unit of human interaction*
2. Understanding values in human-human relationship; meaning of *Nyaya* and program for its fulfillment to ensure *Ubhay-tripti*;
 - a. Trust (*Vishwas*) and Respect (*Samman*) as the foundational values of relationship
3. Understanding the meaning of *Vishwas*; Difference between intention and competence
4. Understanding the meaning of *Samman*, Difference between respect and differentiation; the other salient values in relationship
5. Understanding the harmony in the society (society being an extension of family): *Samadhan*, *Samridhi*, *Abhay*, *Sah-astitvaas* comprehensive Human Goals
6. Visualizing a universal harmonious order in society- Undivided Society (*AkhandSamaj*), Universal Order (*SarvabhaumVyawastha*)- from family to world family!
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 4: Understanding Harmony in the Nature and Existence - Whole existence as Co-existence

1. Understanding the harmony in the Nature
2. Interconnectedness and mutual fulfillment among the four orders of nature-recyclability and self-regulation in nature
3. Understanding Existence as Co-existence (*Sah-astitva*) of mutually interacting units in all-pervasive space
4. Holistic perception of harmony at all levels of existence
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

UNIT 5: Implications of the above Holistic Understanding of Harmony on Professional Ethics

1. Natural acceptance of human values

2. Definitiveness of Ethical Human Conduct
3. Basis for Humanistic Education, Humanistic Constitution and Humanistic Universal Order
4. Competence in professional ethics:
 - a) Ability to utilize the professional competence for augmenting universal human order
 - b) Ability to identify the scope and characteristics of people-friendly and eco-friendly production systems,
 - c) Ability to identify and develop appropriate technologies and management patterns for above production systems.
5. Case studies of typical holistic technologies, management models and production systems
6. Strategy for transition from the present state to Universal Human Order:
 - a) At the level of individual: as socially and ecologically responsible engineers, technologists and managers
 - b) At the level of society: as mutually enriching institutions and organizations
7. To inculcate Human Values among Students: The Role of self, Parents and Teachers
-Practice Exercises and Case Studies will be taken up in Practice Sessions.

Practical Session also Includes Different Yogic Exercises and Meditation Session

INSTRUCTIONAL STRATEGY

The content of this course is to be taught on conceptual basis with plenty of real world examples.

MEANS OF ASSESSMENT

- Assignments and quiz/class tests,
- Mid-term and end-term written tests
- Practical assessment

Reference Material

The primary resource material for teaching this course consists of

a. The text book (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics, Excel books, New Delhi.

b. The teacher's manual (Latest Edition)

R.R Gaur, R Asthana, G P Bagaria, A foundation course in Human Values and professional Ethics – Teachers Manual, Excel books, New Delhi.

In addition, the following reference books may be found useful for supplementary reading in connection with different parts of the course:

1. B L Bajpai, 2004, *Indian Ethos and Modern Management*, New Royal Book Co., Lucknow. Reprinted 2008.
2. PL Dhar, RR Gaur, 1990, *Science and Humanism*, Commonwealth Publishers.
3. Sussan George, 1976, *How the Other Half Dies*, Penguin Press. Reprinted 1986, 1991
4. Ivan Illich, 1974, *Energy & Equity*, The Trinity Press, Worcester, and HarperCollins, USA
5. Donella H. Meadows, Dennis L. Meadows, Jorgen Randers, William W. Behrens III, 1972, *limits to Growth*, Club of Rome's Report, Universe Books.

6. Subhas Palekar, 2000, *How to practice Natural Farming*, Pracheen(Vaidik) Krishi Tantra Shodh, Amravati.
7. A Nagraj, 1998, *Jeevan Vidya ekParichay*, Divya Path Sansthan, Amarkantak.
8. E.F. Schumacher, 1973, *Small is Beautiful: a study of economics as if people mattered*, Blond & Briggs, Britain.
9. A.N. Tripathy, 2003, *Human Values*, New Age International Publishers.

Relevant websites, movies and documentaries

1. Value Education websites, <http://uhv.ac.in>, <http://www.aktu.ac.in>
2. Story of Stuff, <http://www.storyofstuff.com>
3. Al Gore, *An Inconvenient Truth*, Paramount Classics, USA
4. Charlie Chaplin, *Modern Times*, United Artists, USA
5. IIT Delhi, *Modern Technology—the Untold Story*
6. Case study Hevade Bazar Movie
7. RC Shekhar , *Ethical Contradiction* , Trident New Delhi
8. *Gandhi A., Right Here Right Now*, Cyclewala Production

SUGGESTED DISTRIBUTION OF MARKS

Unit	Time Allotted (Periods)	Marks Allotted (%)
1	08	20
2	08	20
3	08	20
4	08	20
5	10	20
Total	42	100

INDUSTRIAL TRAINING

It is needless to emphasize further the importance of Industrial Training of students during their 3 years of studies at Polytechnics. It is industrial training, which provides an opportunity to students to experience the environment and culture of industrial production units and commercial activities undertaken in field organizations. It prepares student for their future role as diploma engineers in the world of work and enables them to integrate theory with practice. Polytechnics have been arranging industrial training of students of various durations to meet the above objectives.

This document includes guided and supervised industrial training of 4 weeks duration to be organised during the semester break starting after second year i.e. after 4th semester examinations. The concerned HODs along with other teachers will guide and help students in arranging appropriate training places relevant to their specific branch. It is suggested that a training schedule may be drawn for each student before starting of the training in consultation with the training providers. Students should also be briefed in advance about the organizational setup, product range, manufacturing process, important machines and materials used in the training organization.

Equally important with the guidance is supervision of students training in the industry/organization by the teachers. Students should be encouraged to write daily report in their diary to enable them to write final report and its presentation later on.

An external assessment of 50 marks has been provided in the study and evaluation scheme of 5th Semester. Evaluation of professional industrial training report through viva-voce/presentation aims at assessing students understanding of materials, industrial process, practices in industry/field organization and their ability to engage in activities related to problem solving in industrial setup as well as understanding of application of knowledge and skills learnt in real life situations.

Teachers and students are requested to see the footnote below the study and evaluation scheme of 4th semester for further details.

The teacher along with field supervisors will conduct performance assessment of students. The components of evaluation will include the following:

- | | |
|--------------------------------------|-----|
| a) Punctuality and regularity | 15% |
| b) Initiative in learning new things | 15% |
| c) Presentation and Viva | 15% |
| d) Industrial training report | 55% |