SRI RAMAKRISHNA MISSION VIDYALAYA
POLYTECHNIC COLLEGE
(AN AUTONOMOUS & ISO 9001:2015 CERTIFIED INSTITUTION)

REGULATIONS AND SYLLABUS

[APPLICABLE TO STUDENTS ADMITTED FROM 2021 - 2022 ACADEMIC YEAR ONWARDS]
(R6 - SCHEME)

DIPLOMA IN MECHANICAL ENGINEERING

Sri Ramakrishna Vidyalaya Post, Coimbatore - 641 020
☎ 80125 33917 ♦ E-mail: ptc@srkv.org ♦ Website: www.srkvtech.org

SRI RAMAKRISHNA MISSION VIDYALAYA POLYTECHNIC COLLEGE
(AN AUTONOMOUS INSTITUTION)
DEPARTMENT OF MECHANICAL ENGINEERING
R6 - SCHEME
[Applicable to students admitted from 2021 - 2022 academic year onwards]
R E G U L A T I O N S

Description of the Course:

The Course for the full time Diploma in Engineering shall extend over a period of three academic years, consisting of 6 semesters. This curriculum for the diploma course is applicable for the candidates admitted from 2021 - 2022 academic year onwards.

Eligibility for the Award of Diploma:

No candidate shall be eligible for the Diploma unless he has undergone the prescribed course of study in this College for a period of not less than three academic years when joined in first year and two years if joined under lateral entry scheme in the second year and passed the prescribed examination. The minimum and maximum period for completion of diploma course is as given below:

Diploma Course	Minimum Period	Maximum Period
Full Time Regular	3 Years	6 Years
Full Time (Lateral Entry)	2 Years	5 Years

Age Limit: No age limit

Subjects of Study and Curriculum Outline:

The subjects of study shall be in accordance with the syllabus prescribed from time to time, both in theory and practical. The curriculum outline under R6-Scheme is given in Annexure - I.

Autonomous Examination - Exam Pattern:

The Autonomous examinations for all the diploma courses are being conducted in the following pattern:

Semester	Span of Study	Examination
I, III & V Sem	June - October	October
II, IV & VI Sem	December - April	April

Autonomous Examinations in all subjects of all the semesters under the scheme of examinations will be conducted at the end of each semester. The internal assessment marks for all the subjects will be awarded on the basis of continuous internal assessment earned during the semester concerned. For each subject 25 marks are allotted for internal assessment and 75 marks are allotted for end semester external examinations.

Continuous Internal Assessment:
A. FOR THEORY SUBJECTS:

The internal assessment marks for a total of 25 marks, which are to be distributed as follows:
i) Subject Attendance   **05 Marks**

Award of marks for subject attendance to each subject Theory / Practical will be as per the range given below:

80% - 83%	1 mark
84% - 87%	2 marks
88% - 91%	3 marks
92% - 95%	4 marks
96% - 100%	5 marks

ii) Test   **10 Marks**

Two Tests each of 2 hours duration for a total of 50 marks are to be conducted.   **05 marks**
Out of which the best one will be taken and the marks to be reduced to

The Test - III is to be the Model test of 3 hours duration for a total of 100 marks   **05 marks**
covering all the five units and the question paper will be end semester
examination pattern. The marks obtained will be reduced to

                                                                                                   Total   10 marks

Test	Units	When to conduct	Marks	Duration
Test I	Unit - I & II	End of 6th week	50	2 Hrs
Test II	Unit - III & IV	End of 12th week	50	2 Hrs
Test III	Model Examination: All the 5 units. (End sem. exam question pattern)	End of 16th week	100	3 Hrs

iii) Assignment   **05 Marks**

      For each subject three assignments are to be given each for 20 marks and the average
marks scored should be reduced for 05 marks.

iv) Seminar Presentation   **05 Marks**

      The students have to select the topics either from the subjects or general subjects which
will help to improve the grasping capacity as well as the capacity to express the subject in hand.
The students will be allowed to prepare the material for the given topic using the library hour and
they will be permitted to present the seminar. (For Second Year, the students will be permitted to
present the seminar as a group not exceeding six members and each member of the group
should participate in the presentation. For the Third Year, the students should present the
seminar individually).

      The seminar presentation is mandatory for all theory subjects and carries 05 marks for
each theory subject. The respective subject faculty may suggest topics to the students and will
evaluate the submitted materials and seminar presentation. (2½ marks for the material submitted
in writing and 2½ marks for the seminar presentation). For each subject minimum of two
seminars are to be given and the average marks scored should be reduced to 05 marks.

      All test papers, assignment papers and the seminar presentation written materials after
getting the signature with date from the students must be kept in safe custody in the department
for verification and audit. It should be preserved for one semester after publication of end
semester exam results.

B. FOR PRACTICAL SUBJECTS:

      The internal assessment mark for a total of 25 marks which are to be distributed as
follows:-

a)	Attendance (Award of marks same as theory subjects)	05 Marks
b)	Procedure / observation and tabulation / Other practical related work	10 Marks
c)	Record writing	10 Marks
	TOTAL	**25 Marks**

➢ *All the experiments / exercises indicated in the syllabus should be completed and the same to be given for final semester examinations.*

➢ *The record for every exercise should be submitted in the subsequent Practical classes and marks should be awarded for 20 for each exercise as per the above allocation.*

➢ *At the end of the semester, the average marks of all the exercises should be calculated for 20 marks and the marks awarded for attendance is to be added to arrive at the internal assessment mark for practical. (20 + 5 = 25 marks)*

➢ *The students have to submit the duly signed bonafide record notebook / file during the end semester practical examinations.*

➢ *All the marks awarded for assignments, tests and attendance should be entered in the Personal Log Book of the staff, who is handling the subject. This is applicable to both theory and practical subjects.*

Project Work and Internship:

The students of all the branches have to do a project work in the final semester as part of the Curriculum and in partial fulfillment for the award of Diploma by the State Board of Technical Education and Training, Tamil Nadu. The project work must be reviewed twice in the same semester. The project work is approved during the fifth semester by the properly constituted committee with guidelines. Proper record should be maintained for the two project reviews and preserved for one semester after the publication of end semester exams results.

a) Internal assessment mark for Project Work & Internship:

a)	Attendance (Award of marks same as theory pattern)	05	Marks
b)	Project Review - I	10	Marks
c)	Project Review - II	10	Marks
	TOTAL	**25**	**Marks**

b) Allocation of Marks for Project Work & Internship in Autonomous Examination:

a)	Demonstration / Presentation	25	Marks
b)	Project Report	25	Marks
c)	Viva-Voce	30	Marks
d)	Internship Training Report	20	Marks
	TOTAL	**100**	**Marks**

c) Internship Report:

The internship training for a period of two weeks shall be undergone by every student at the end of IV / V semester during vacation. The certificate shall be produced along with the internship training report for evaluation. The evaluation of internship training shall be done along with final year "Project Work" for 20 marks. The internship shall be undertaken in any Industry / Government or Private certified agencies which are in Social Sector / Government Skill Centers / Institutions / Schemes. A neatly prepared PROJECT REPORT as per the format has to be submitted by the individual student during the end semester examination.

END SEMESTER AUTONOMOUS EXAMINATIONS
QUESTION PAPER PATTERN FOR FIRST YEAR SUBJECTS
(General Question paper pattern for theory subjects, unless specified)

Time: 3 Hrs **Max. Marks: 100**

PART – A (5 x 1 = 05 marks)

Sl. No. : 1 to 5

Five questions will be asked. 1 question from each unit. Answer all the FIVE questions. Each question carries 1 mark.

PART – B (10 x 2 = 20 marks)

Sl. No. : 6 to 20

Fifteen questions will be asked. 3 questions from each unit. Answer any TEN questions. Each question carries 2 marks.

PART – C (5 x 15 = 75 marks)

Sl. No. : 21 to 25

Five questions will be asked. 1 question from each unit. Each question carries 15 marks. In each question, answer either A or B. Questions A and B have two subdivisions (i) and (ii) carrying 8 marks and 7 marks.

END SEMESTER AUTONOMOUS EXAMINATIONS
QUESTION PAPER PATTERN FOR SECOND AND THIRD YEAR SUBJECTS
(General Question paper pattern for theory subjects, unless specified)

Time: 3 Hrs **Max. Marks: 100**

PART - A (10 x 3 = 30 marks)

Sl. No. : 1 to 10

Ten questions will be asked with at least two questions from each unit. All the Ten Questions are to be answered. Each question carries 3 marks.

PART - B (5 x 14 = 70 marks)

Sl. No. : 11 to 15

Five Questions will be asked with one question from each unit in **either - or** pattern. Students have to answer all the five questions. Each question carries 14 marks. (Based on the discretion of the question setter, he / she can ask two seven mark questions (with sub division (i) & sub division (ii)) instead of one 14 marks question, if required).

Any tables required, should be mentioned in the question paper like Steam table, IS Code Book, Steel table, Design Data Book, Mollier chart, Psychometric Chart etc.,

 *Examination will be conducted for 100 marks and will be converted to 75 marks.

Scheme of Examinations:

The Scheme of examinations for subjects under R6-Scheme is given in Annexure - II.

Requirements to appear for Examinations:

A candidate will be permitted to appear for the end semester Autonomous Examinations, only if he secures a minimum of overall 80% attendance in the semester concerned and pay the required examination fees in time.

Criteria for Pass:

1. No candidate shall be eligible for the award of Diploma unless he has undergone the prescribed course of study successfully and pass all the subjects prescribed in the curriculum.
2. A candidate shall be declared to have passed the examination in a subject if he secures not less than 40% in theory subjects and 50% in practical subjects out of the total prescribed maximum marks including both the internal assessment and the end semester examinations marks put together, subject to the condition that he secures at least a minimum of 30 marks out of 75 marks in the theory examinations and a minimum of 35 marks out of 75 marks in the practical examinations.

Condonation of Attendance:

The minimum overall percentage of attendance required for a candidate to become eligible to write the Autonomous End Semester Examination is 80%. Under extraordinary circumstances, for genuine and valid reasons including medical reasons, the Principal may condone up to a maximum of 10% shortage to a candidate, subject to the condition that he satisfies all the other requirements to appear for the Autonomous Examinations.

Under no circumstances a candidate with attendance less than 70% shall be permitted to write the Autonomous Examinations. The condonement of 10% shortage shall not be done as a routine to all candidates, but only for genuine cases; it shall not be claimed as a matter of right by all candidates.

Classification of successful candidates:

Classification of candidates who will pass out the final examinations from April 2024 onwards (Joined in first year in 2021-2022) in R6-scheme is being done as specified below.

First Class with Superlative Distinction:

A candidate will be declared to have passed in *First Class with Superlative Distinction*, if he secures not less than 75% of the marks in all the subjects and passes all the semesters in the first appearance itself and passes all subjects within the stipulated period of study of 3 / 2 years (3 years for regular entry / 2 years for lateral entry) without any break.

First Class with Distinction:

A candidate will be declared to have passed in *First Class with Distinction*, if he secures not less than 75% of the aggregate marks in all the semesters put together and passes all the semesters except the I and II semester in the first appearance itself and passes all subjects within the

stipulated period of study of 3 / 2 years (3 years for regular entry / 2 years for lateral entry) without any break.

First Class:

A candidate will be declared to have passed in *First Class,* if he secures not less than 60% of the aggregate marks in all the semesters put together and passes all the subjects within the stipulated period of study 3 / 2 years (3 years for regular entry / 2 years for lateral entry) without any break.

Second Class:

All other successful candidates will be declared to have passed in *Second Class.*

Duration of a period in the Class Time Table:

The duration of each period of instruction is 1 hour and the total period of instruction hours excluding interval and lunch break in a day should be 7 hours corresponding to 7 periods of instruction (Theory & Practical).

ANNEXURE - I
Subjects of Study and Curriculum Outline (R6 - Scheme)

FIRST SEMESTER

No. of weeks per semester: 16 weeks

Subject Code	Subject	Hours per Week			
		Theory	Drawing	Practical	Total
6011	Communicative English - I	5			5
6012	Engineering Mathematics - I	5			5
6013	Engineering Physics - I	5			5
6014	Engineering Chemistry - I	5			5
6015	Engineering Graphics - I		6		6
6016	Engineering Physics Practical - I			2	2
6017	Engineering Chemistry Practical - I			2	2
6018	Workshop Practical - I			3	3
6001	Communication Skill Practical			2	2
	TOTAL	20	6	9	35

Extra / Co-curricular Activities:

Sub. Code	Subject	Hrs / Week
6003	Physical Education	2
6004	Library	1
6005	Value Education	1

SECOND SEMESTER

No. of weeks per semester: 16 weeks

Subject Code	Subject	Hours per Week			
		Theory	Drawing	Practical	Total
6021	Communicative English - II	4			4
6022	Engineering Mathematics - II	5			5
6023	Engineering Physics - II	5			5
6024	Engineering Chemistry - II	5			5
6025	Engineering Graphics - II		5		5
6026	Engineering Physics Practical - II			2	2
6027	Engineering Chemistry Practical - II			2	2
6028	Basics of Industries and Workshop Practical - II	2		3	5
6002	Computer Applications Practical			2	2
	TOTAL	21	5	9	35

Extra / Co-curricular Activities:

Sub. Code	Subject	Hrs / Week
6003	Physical Education	2
6004	Library	1
6005	Value Education	1

THIRD SEMESTER

No. of weeks per semester: 16 weeks

SUB. CODE	SUBJECT	HOURS PER WEEK			
		Theory	Drawing	Practical	Total
6231	Strength of Materials	6	-	-	6
6232	Manufacturing Technology - I	5	-	-	5
6233	Measurements and Metrology	5	-	-	5
6234	Electrical Drives and Controls	6	-	-	6
6235	Machine Drawing and CAD Practical	-	3	2	5
6236	Manufacturing Technology - I Practical	-	-	4	4
6237	Electrical Drives and Control Practical	-	-	4	4
	TOTAL	22	03	10	35

Extra / Co-curricular Activities:

SUB. CODE	SUBJECT	HRS / WEEK
6003	Physical Education	2
6004	Library	1
6005	Value Education	1

FOURTH SEMESTER

No. of weeks per semester: 16 weeks

SUB. CODE	SUBJECT	HOURS PER WEEK			
		Theory	Drawing	Practical	Total
6241	Fluid Mechanics and Fluid Power	6	-	-	6
6242	Manufacturing Technology II	6	-	-	6
6243	Thermal Engineering - I	6	-	-	6
6244	Production and Quality Management	5	-	-	5
6245	Strength of Materials & Fluid Mechanics Practical	-	-	4	4
6246	Manufacturing Technology II Practical	-	-	4	4
6247	Measurements and Metrology Practical	-	-	4	4
	TOTAL	23	-	12	35

Extra / Co-curricular Activities:

SUB. CODE	SUBJECT	HRS / WEEK
6003	Physical Education	2
6004	Library	1
6005	Value Education	1

FIFTH SEMESTER

No. of weeks per semester: 16 weeks

SUB. CODE	SUBJECT	HOURS PER WEEK			
		Theory	Drawing	Practical	Total
6251	Design of Machine Elements	6	-	-	6
6252	Thermal Engineering - II	7	-	-	7
6253.1	Automobile Technology				
6253.2	Green Energy and Energy Conservation	6	-	-	6
6253.3	Mechatronics				
6254	Process Automation Practical	-	-	4	4

6255	Thermal Engineering Practical	-	-	4	4

SUB. CODE	SUBJECT	HRS / WEEK
6003	Physical Education	2
6004	Library	1

6256.1	Automobile Technology Practical	-	-	4	4
6256.2	Green Energy & Energy Conservation Practical				
6256.3	Mechatronics Practical				
6257	Entrepreneurship & Startups	-	-	4	4
	TOTAL	**19**	**-**	**16**	**35**

Extra / Co-curricular Activities:

SIXTH SEMESTER

No. of weeks per semester: 16 weeks

SUB. CODE	SUBJECT	HOURS PER WEEK			
		Theory	Drawing	Practical	Total
6261	Industrial Engineering and Management	6	-	-	6
6262	E Vehicle Technology and Policy	5	-	-	5
6263.1	Computer Integrated Manufacturing	6	-	-	6
6263.2	Welding Technology				
6263.3	Refrigeration and Air Conditioning				
6264	Solid Modelling Practical	-	-	6	6
6265.1	Computer Integrated Manufacturing Practical	-	-	6	6
6265.2	Welding Technology Practical				
6265.3	Refrigeration and Air Conditioning Practical				
6266	Project Work and Internship	-	-	6	6
	TOTAL	**17**	**-**	**18**	**35**

Extra / Co-curricular Activities:

SUB. CODE	SUBJECT	HRS / WEEK
6003	Physical Education	2
6004	Library	1

ANNEXURE - II
SCHEME OF EXAMINATIONS

					Scheme of Examination			
Sub. Code	**Name of the Subject**	**Periods / Week**	**Periods / Semester**	**Exam Duration in Hrs**	**Allocation of Marks**			**Minimum for Pass**
					Internal	External*	Total	

FIRST SEMESTER

6011	Communicative English - I	5	80	3	25	75	100	40
6012	Engineering Mathematics - I	5	80	3	25	75	100	40
6013	Engineering Physics - I	5	80	3	25	75	100	40
6014	Engineering Chemistry - I	5	80	3	25	75	100	40
6015	Engineering Graphics - I	6	96	3	25	75	100	40
6016	Engineering Physics Practical - I	2	32	3	25	75	100	50
6017	Engineering Chemistry Practical - I	2	32	3	25	75	100	50
6018	Workshop Practical - I	3	45	3	25	75	100	50
6001	Communication Skill Practical	2	32	3	25	75	100	50

SECOND SEMESTER

6021	Communicative English - II	4	64	3	25	75	100	40
6022	Engineering Mathematics - II	5	80	3	25	75	100	40
6023	Engineering Physics - II	5	80	3	25	75	100	40
6024	Engineering Chemistry - II	5	80	3	25	75	100	40
6025	Engineering Graphics - II	5	80	3	25	75	100	40
6026	Engineering Physics Practical - II	2	32	3	25	75	100	50
6027	Engineering Chemistry Practical - II	2	32	3	25	75	100	50
6028	Basics of Industries & Workshop Practical - II	5	80	3	25	75	100	50
6002	Computer Applications Practical (DCE & DME)	2	32	3	25	75	100	50

THIRD SEMESTER								
6231	Strength of Materials	6	96	3	25	75	100	40
6232	Manufacturing Technology - I	5	80	3	25	75	100	40
6233	Measurements and Metrology	5	80	3	25	75	100	40
6234	Electrical Drives and Controls	6	96	3	25	75	100	40
6235	Machine Drawing and CAD Practical	5	80	3	25	75	100	40
6236	Manufacturing Technology - I Practical	4	64	3	25	75	100	50
6237	Electrical Drives and Control Practical	4	64	3	25	75	100	50

FOURTH SEMESTER								
6241	Fluid Mechanics and Fluid Power	6	96	3	25	75	100	40
6242	Manufacturing Technology II	6	96	3	25	75	100	40
6243	Thermal Engineering - I	6	96	3	25	75	100	40
6244	Production and Quality Management	5	80	3	25	75	100	40
6245	Strength of Materials and Fluid Mechanics Practical	4	64	3	25	75	100	50
6246	Manufacturing Technology II Practical	4	64	3	25	75	100	50
6247	Measurements and Metrology Practical	4	64	3	25	75	100	50

FIFTH SEMESTER								
6251	Design of Machine Elements	6	96	3	25	75	100	40
6252	Thermal Engineering - II	6	96	3	25	75	100	40
6253.1	Automobile Technology							
6253.2	Green Energy and Energy Conservation	6	96	3	25	75	100	40
6253.3	Mechatronics							
6254	Process Automation Practical	4	64	3	25	75	100	50
6255	Thermal Engineering Practical	4	64	3	25	75	100	50
6256.1	Automobile Technology Practical							
6256.2	Green Energy & Energy Conservation Practical	4	64	3	25	75	100	50
6256.3	Mechatronics Practical							
6257	Entrepreneurship & Startups	5	80	3	25	75	100	50

SIXTH SEMESTER								
6261	Industrial Engineering and Management	6	96	3	25	75	100	40
6262	E Vehicle Technology and Policy	5	80	3	25	75	100	40
6263.1	Computer Integrated Manufacturing							
6263.2	Welding Technology	6	96	3	25	75	100	40
6263.3	Refrigeration and Air Conditioning							
6264	Solid Modelling Practical	6	96	3	25	75	100	50
6265.1	Computer Integrated Manufacturing Practical							
6265.2	Welding Technology Practical	6	96	3	25	75	100	50
6265.3	Refrigeration & Air Conditioning Practical							
6266	Project Work and Internship	6	96	3	25	75	100	50

FIRST SEMESTER
6011 COMMUNICATIVE ENGLISH - I

SUBJECT	INSTRUCTION		EXAMINATION			
6011 COMMUNICATIVE ENGLISH - I	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	5 Hrs	80 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**Functional Grammar and Usage** Parts of SpeechFunctional Units Use of Main Verb & Auxiliary Verb Application of Tense Forms (Simple Present, Present Continuous, Present Perfect, Simple Past, Past Continuous, Past Perfect, Simple Future, Future Continuous only) Framing Yes / No QuestionsFraming Wh-Questions Application of Active Voice and Passive Voice Use of Prepositions Articles	**17**
II	**Vocabulary Enrichment** Synonyms and Antonyms Word Conversion (selective 25 words) Collocation – Noun with Verb, Adjective with Noun (Selective 25 Collocations) Homophones (selective 25 homophones)One-word Substitution (Textual) Idiomatic expressions for Daily Life (frequently used 25 expressions) Frequently Used Phrasal verbs (selective 25 Phrasal verbs)	**15**
III	**Situational English** Dialogue for Day to Day Situations Short Messages for e-Communication Letter Writing for Academic Purpose (Leave Application, Requisition for Bonafide Certificate, Applying for TC) Writing the Essentials Comprehension Framing questions based on the given situation	**15**
IV	**Creative English** Review Writing (Book / Movie / TV Program)Visual Description Advertisement Writing Word Cloud Transforming Verbal Passage into Graphics	**15**
V	**English for Scholarly Presentation/ Fluency** "A Snake in the Grass" by R.K. Narayan "Of Parents and Children" by Francis Bacon"On His Blindness" by John Milton "When I Have Fears" by John Keats	**11**

Reference Books:
Glossaries
> https://www.engineering-dictionary.com/ https://techterms.com/definition/ http://dictionary.tamilcube.com/
> https://www.lexilogos.com/english/tamil_dictionary.htm

Grammar
1. Just Enough English Grammar Illustrated, Gabriele Stobbe, McGraw-HillOsborne Media, 2008
2. Visual Guide to Grammar and Punctuation, DK Publishing, 2017

3. English Grammar in Use, Raymond Murphy, Cambridge University Press, 2019
4. Intermediate English Grammar, Raymond Murphy, Cambridge University Press,Second Edition.
5. Essential English Grammar, Raymond Murphy, Cambridge University Press,New edition.

Enrichment of Study

1. Enrich Your Vocabulary: Vocabulary for General, Placement & Competitive Exams by Edin Brow

Motivation

1. An Autobiography; Or, The Story of My Experiments with Truth, Mahatma Gandhi, Penguin Books, 2001
2. You Can Win, Shiv Khera, New Dawn Press, 2004
3. Chicken Soup for the Soul, Jack Canfield, Mark Victor Hansen, 2001
4. How to Win Friends and Influence People by Dale Carnegie

QUESTION PAPER PATTERN

Continuous Assessment Test - I:

Time: 2 Hrs.   Max. Marks: 50

Sl. No	Questions	Marks
1	Answer any TEN out of 15 questions	10 x 5 = 50

Continuous Assessment Test - II:

Time: 2 Hrs.   Max. Marks: 50

Sl. No	Questions	Marks
1	Answer any TEN questions	10 x 5 = 50

Model Examination / End semester Examination

Time: 3 Hrs.   Max. Marks: 100

Sl. No	Questions	Portions	Marks
1	Answer any TEN out of 16 questions	Unit I & II - Grammar items	10 x 4 = 40
2	Answer any FOUR out of 6 questions	Unit III - Composition items	4 x 5 = 20
3	Answer any FOUR out of 5 questions	Unit IV - Composition items	4 x 5 = 20
4	Answer any FOUR out of 5 questions	Unit V - Prose & Poetry	4 x 5 = 20
		TOTAL	**100**

6012 ENGINEERING MATHEMATICS - I

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			
6012 ENGINEERING MATHEMATICS – I	5 Hrs	80 Hrs	**Internal Assessment**	**External Exam***	**Total**	**Duration**
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**ALGEBRA** **1.1 MATRICES AND DETERMINANTS MATRICES**: Definition, concept and types of matrices. **DETERMINANTS:** Determinant of a square matrix - 2nd and 3rd order determinants - singular and non-singular matrices - simple problems.	**4**
	1.2 APPLICATIONS OF MATRICES AND DETERMINANTS Co-factor, Adjoint of matrix, Inverse of matrix and rank of a matrix by determinant method - simple problems. Solution of simultaneous equations using Cramer's rule - simple problems.	**5**
	1.3 BINOMIAL THEOREM Introduction - Factorial, Permutation and Combinations - Values of nPr and nCr (Results only - not for examination).	**5**

	Statement of Binomial theorem for positive integral index - Expansion of Binomial - Finding general term - Middle term - Coefficient of x^n and Term independent of x - Binomial theorem for rational index up to 3. Applications of Binomial theorem - simple problems.	
II	**COMPLEX NUMBERS** **2.1 ALGEBRA OF COMPLEX NUMBERS** Introduction - Complex numbers - Conjugates - Algebra of complex numbers (without geometrical proof), Properties of complex conjugates - Modulus and amplitude - Polar and Euler form of a complex number - simple problems.	**5**
	Argand diagram - Collinear points, four points forming square, rectangle, rhombus and parallelogram only - simple problems. **2.2 DE MOIVRE'S THEOREM** De Moivre's Theorem (statement and applications) - related simple problems.	**5**
	2.3 ROOTS OF COMPLEX NUMBERS Finding the nth roots of unity - solving the equations of the form $X^n \pm 1 = 0$, where $n \le 7$ - simple problems.	**5**
III	**TRIGONOMETRY** **3.1 TRIGONOMETRIC IDENTITIES** Trigonometric ratios of sum and difference of two angles - Multiple and sub-multiple angles - Functions of 3A angles - simple problems.	**7**
	3.2 INVERSE TRIGONOMETRIC FUNCTIONS Sum and product identities - Inverse trigonometric functions - Principal value - Properties of inverse trigonometric functions - simple problems.	**8**
IV	**DIFFERENTIAL CALCULUS - I** **4.1 LIMITS** Definition of limits - Problems using the following results $(i)\ \underset{x \to a}{Lt}\ \dfrac{x^n - a^n}{x - a} = na^{n-1}\ (ii)\ \underset{\theta \to 0}{Lt}\ \dfrac{Sin\theta}{\theta} = 1$ $(iii)\ \underset{\theta \to 0}{Lt}\ \dfrac{\tan\theta}{\theta} = 1\ (\theta\ in\ radians)(\text{Re}sults\ only)$	**5**
	4.2 DIFFERENTIATION The derivative of a function - Differentiation of constant, $X^n, \sin x, \cos x, \tan x, \sec x, \cos ecx, \cot x, \log x, e^x, a^x, \sin^{-1} x,\ \cos^{-1} x, \tan^{-1} x, \cot^{-1} x, \sec^{-1} x$ $and \cos ec^{-1}x$ (Formulae only) - Differentiation rules: $u \pm v, uv, uvw, u/v$ - simple problems.	**5**
	4.3 DIFFERENTIATION METHODS Chain rule - Differentiation of Implicit functions - Differentiation of parametric functions - simple problems.	**5**
V	**DIFFERENTIAL CALCULUS - II** **5.1 SUCCESSIVE DIFFERENTIATION** Successive differentiation up to second order (parametric form not included). Definition of differential equation, order and degree, formation of differential equation - simple problems.	**7**
	5.2 PARTIAL DIFFERENTIATION Definition - Partial differentiation of two variables up to second order only - simple problems.	**7**

Reference Books:
1. Higher Secondary +1 Mathematics volume I & II. Tamil Nadu Text Book Corporation.
2. Higher Secondary +2 Mathematics Volume I & II. Tamil Nadu Text Book Corporation.
3. Engineering Mathematics V. Sundaram, R. Balasubramanian.
4. Engineering Mathematics - I C.B.Gupta ,A.K.Malik, New age international Pub., 1sted, - 2008.
5. Differential Calculus S. Balachandra Rao, CK Shantha New age Publishers
6. Probability Theory and Stochastic Process B.Prabhakara Rao, TSR Murthy, BS Publishers.
7. Vectors and Geometry GS. Pandey, RR Sharma, New age international publishers.
8. Engineering Mathematics - I Guruprasad Samanta, New age int. publishers, 2ndedition 2015

9. Engineering Mathematics Reena Garg, Khanna pub. house, New Delhi, Revised edn. -2018.
10. Engineering Mathematics Volume I P. Kandasamy and K. Thilagavathy, S. Chand & Co. Ltd.

Question Paper Pattern: General Pattern

6013 ENGINEERING PHYSICS - I

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6013 ENGINEERING PHYSICS - I			Internal Assessment	External Exam*	Total	
	5 Hrs	80 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**SI UNITS AND STATICS** **1.1 UNITS AND MEASUREMENTS** Unit - Definition - Fundamental Quantities - Definition - Seven fundamental quantities - SI units and symbols for the seven fundamental quantities - Dimensional formula for length, mass and time - Supplementary quantities - Plane angle and Solid angle - SI units and symbols for the supplementary quantities - Derived quantities - Definition - SI units, symbols and derivation of dimensional formula for the derived quantities (area, volume, density, velocity, momentum, acceleration, force, impulse, work or energy and power) - Uses of Dimensional formula - Different types of measurement systems - Conventions to be followed while writing SI units - Multiples and sub-multiples of units and their prefixes - Unit conversions (Horse power to Watt and Calorie to Joule) - Applications of the method of dimensional analysis.	6
	1.2 STATICS Scalar & vector quantities - Definition & examples - Concurrent and coplanar forces - Definition - Resolution of a vector into two perpendicular components - Resultant and equilibrant - Definition - Parallelogram law of forces - Statement - Expressions for magnitude and direction of the resultant of two forces acting at a point with an acute angle between them - Lami's theorem - Statement and explanation - Experimental verification of parallelogram law of forces and Lami's theorem - Simple problems based on expressions for magnitude and direction of resultant - Moment of a force - Clockwise and anti-clockwise moments - Principle of moments - Couple - Torque acting due to a couple - Experimental determination of mass of the given body using principle of moments.	9
II	**DYNAMICS - I** **2.1 STRAIGHT LINE MOTION** Introduction - Distance - Displacement - Speed - Velocity - Acceleration - Acceleration due to gravity - Definitions - Difference between mass and weight - Newton's laws of motion - Fundamental Equations of motion for objects - in horizontal motion - Falling freely - Thrown vertically upwards.	3
	2.2 PROJECTILE MOTION Projectile motion - Angle of projection - Trajectory - Maximum height - Time of flight - Horizontal range - Definitions - Expressions for maximum height, time of flight and horizontal range - Condition for getting the maximum range of the projectile - Path of the projectile is a Parabola - Simple problems based on expressions for maximum height, time of flight and horizontal range - Examples of projectile motion.	5
	2.3 CIRCULAR MOTION Circular motion - Angular velocity - Period - Frequency - Definitions - Relation	

	between linear velocity and angular velocity - Introduction to Degrees and radians - Relation between angular velocity, period and frequency - Normal acceleration - Centripetal force - Centrifugal force - Definitions - Expressions for normal acceleration and centripetal force - Banking of curved paths - Angle of banking - Definition - Expression for the angle of banking of a curved path - Simple harmonic motion - Amplitude, frequency and period - Definitions - Simple problems based on the expressions for centripetal force and angle of banking - Applications of centripetal force and centrifugal force.	7
III	**DYNAMICS - II** **3.1 ROTATIONAL MOTION OF RIGID BODIES** Rigid body - Definition - Moment of inertia of a particle about an axis - Moment of inertia of a rigid body about an axis - Radius of gyration - Definition - Expression for the kinetic energy of a rotating rigid body about an axis - Angular momentum - Definition - Expression for the angular momentum of a rotating rigid body about an axis - Law of conservation of angular momentum - Examples.	5
	3.2 GRAVITATION Newton's laws of gravitation - Acceleration due to gravity on the surface of earth - Expression for variation of acceleration due to gravity with altitude.	4
	3.3 SATELLITES Satellites - Natural and artificial - Escape velocity and orbital velocity - Definitions - Expression for escape velocity and orbital velocity - Polar and Geostationary satellites - Uses of artificial satellites - Simple problems based on escape velocity and orbital velocity.	5
IV	**PROPERTIES OF MATTER** **4.1 ELASTICITY** Elastic and plastic bodies - Definition - Stress - Strain - Definitions - Hooke's law - Statement - Types of strain - Elastic and plastic limit - Young's modulus - Bulk modulus - Rigidity modulus - Definitions - Uniform and non-uniform bending of beams - Experimental determination of the Young's modulus of the material of a beam by uniform bending method - Poisson's ratio - Simple problems based on stress, strain and Young's modulus - Applications of elasticity.	4
	4.2 FLUID STATICS Introduction - Pressure - Definition - Pressure due to fluid column at rest - Pascal's law and its applications - Hydraulic lift and hydraulic brake - Buoyancy - Archimede's Principle - Law of floatation.	3
	4.3 VISCOSITY Viscous force - Viscosity - Coefficient of viscosity - Definitions - SI unit and dimensional formula for coefficient of viscosity - Streamline flow - Turbulent flow - Critical velocity - Reynolds number - Definition - Experimental comparison of coefficient of viscosity of two low viscous liquids - Terminal velocity - Definition - Experimental determination of coefficient of viscosity of a highly viscous liquid by Stoke's method - Practical applications of viscosity - Practical applications of Stoke's law.	4
	4.4 SURFACE TENSION Surface tension - Angle of contact - Definitions - Expression for surface tension of a liquid by capillary rise method - Experimental determination of surface tension of water by capillary rise method - Practical applications of capillarity - Simple problems based on expression for surface tension - Applications of surface tension.	4
V	**SOUND AND MAGNETISM** **5.1 SOUND** Wave motion - Introduction and definition - Audible range - Infrasonic - Ultrasonics - Progressive waves, longitudinal and transverse waves - Examples - Amplitude, Wave length, period and frequency of a wave - Definitions - Relation between wavelength, frequency and velocity of a wave - Stationary or standing waves - Vibrations - Free vibrations, forced vibrations and resonance - Definitions and examples - Laws of transverse vibration of a stretched string - Sonometer - Experimental determination of frequency of a tuning fork - Simple	6

problems based on expression for frequency of vibration - Doppler effect - Definition and applications - Ultrasonic and its uses - SONAR. **5.2 ACOUSTICS OF BUILDINGS** Acoustics of buildings - Echo - Reverberation - Reverberation time - Sabine's formula for reverberation time - Coefficient of sound absorption - Noise pollution.	**3**
5.3 MAGNETISM Pole strength - Definitions - Magnetic moment, intensity of magnetisation, magnetising field intensity, magnetic induction, Permeability, hysteresis, saturation, retentivity & coercivity-Definitions - Method of drawing hysteresis loop of specimen using a solenoid - Uses of hysteresis loop - Simple problems based on intensity of magnetization-Types of magnetic materials & their applications.	**5**

Reference Books:

1. Fundamentals of Physics - Halliday & Resnick - Wiley India Pvt. Ltd. - Sixth Edition.
2. Physics for Higher Secondary - First & Second year - Volume I & II - Tamilnadu Textbook and Educational Services Corporation, 2018.
3. Engineering Physics - B.L.Theraja - S. Chand & Company Ltd. - Fourth Edition.
4. A text book of sound - R.L.Saighal - S. Chand Publishing - 2005.
5. A textbook of Applied Mechanics - R. S. Khurmi - S. Chand & Company Ltd. - Twelfth Edition.

Question Paper Pattern: General Pattern

6014 ENGINEERING CHEMISTRY - I

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6014 ENGINEERING CHEMISTRY - I	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	5 Hrs	80 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**TECHNOLOGY OF WATER AND ACIDS AND BASES** **1.1 TECHNOLOGY OF WATER** Sources of water - Reasons for depletion of underground water - Rainwater harvesting (basic concepts) - Advantages - Hard water and soft water - Hardness of water - Carbonate and non-carbonate hardness - Disadvantages of hard water - Methods of expressing hardness - mg/lit and ppm - Simple problems - Softening of hard water - Ion-exchange method and Reverse osmosis method - Municipal water supply - Purification of drinking water (sedimentation, filtration and sterilization) - Disadvantages of using hard water in boilers - Scale formation - Corrosion of boiler metal - Caustic Embrittlement - Priming and foaming.	**9**
	1.2 ACIDS AND BASES Theories of acids and bases - Arrhenius theory - Lowry-Bronsted theory - Lewis theory - Advantages of Lewis theory - pH and pOH - Definition - Numerical problems - Indicator - Definition - Buffer solution - Definition - Types of buffer solution with examples - Application of pH in industries.	**6**
II	**ATOMIC STRUCTURE AND CHEMICAL BONDING, NUCLEAR CHEMISTRY** **2.1 ATOMIC STRUCTURE AND CHEMICAL BONDING** Fundamental particles - Proton - Electron - Neutron - Atomic number - Mass number - Extra nuclear part - Filling up of electrons - Aufbau principle - s-p-d-f orbital's - Electronic configuration - Definition of atomic mass, molecular mass, equivalent mass, valency (definitions only) - Octet rule - Electrovalent bond - Sodium chloride formation - Covalent bond - Formation of ammonia.	**6**
	2.2 NUCLEAR CHEMISTRY Natural radio activity - Definition - Alpha, beta, gamma rays - Comparison of	

	alpha, beta, gamma particles - Atomic theory - Isotopes, Isobars and Isotones - Definition - Examples - Radioactive decay - Alpha and beta decay with example - Group displacement law - Half life period - Definition - Simple problems - Artificial radioactivity - Definition - Example - Nuclear fission and Nuclear fusion - Definition - Fission of U235 - Fusion reaction in the Sun - Nuclear reactor - Definition - Types of nuclear reactors - Components nuclear reactor - Reactor core, reflector, pressure vessel, shielding, heat exchanger and turbine - Application of radioactive isotopes.	8
III	**SOLUTION, COLLOIDS AND CATALYSIS** **3.1 SOLUTION** Definition - Methods of expressing concentration of solutions - Percentage by mass, normality, molarity, molality, and mole fraction - Simple problems.	4
	3.2 COLLOIDS True solution and colloidal solution - Definition - Differences - Types of Colloids - Lyophilic and lyophobic colloids - Differences - Properties - Tyndall effect, Brownian movement, Electrophoresis and Coagulation - Industrial applications of colloids - Smoke precipitation by Cottrell's method - Purification of water - Cleansing action of soap - Tanning of leather and sewage disposal.	6
	3.3 CATALYSIS Catalyst - Definition - Types of catalyst - Positive catalyst - Negative catalyst - Catalysis - Definition - Types of catalysis - Homogeneous and heterogeneous - Promoter - Catalyst poison - Definition - Characteristics of a catalyst - Industrial applications of catalysts.	4
IV	**ELECTROCHEMISTRY, ELECTROCHEMICAL CELL & ENERGY SOURCES** **4.1 ELECTROCHEMISTRY** Electrolyte - Definition - Strong and weak electrolytes – non-electrolytes - Examples - Electrolysis - Definition - Mechanism - Industrial application of electrolysis - Electroplating - Chrome plating - Preparation of surface process - Factors affecting the stability of the coating - Electroless plating - Definition - Advantages of electroless plating over electroplating - Applications of electroless plating.	5
	4.2 ELECTROCHEMICAL CELL Electrochemical cell - Definition - Single electrode potential - Definition - Galvanic cell - Formation of Daniel cell - Electrochemical series - Definition and significance - Concentration cell - Definition - Types of concentration cell - Electrode concentration cell and Electrolyte concentration cell.	5
	4.3 ENERGY SOURCES Primary Battery - Definition and example - Construction, working and uses of dry cell - Secondary battery - Definition and example - Construction, working and uses of lead acid storage battery - Nickel Cadmium battery - Solar cell - Definition - Principle, construction, working and uses.	5
V	**GLASS, CERAMICS, ABRASIVES AND LUBRICANTS** **5.1 GLASS** Composition of glass - Manufacture of glass (Soda lime glass - Annealing of glass - Varieties of glass - Optical glass, wind shield glass and photo chromatic glass.	4
	5.2 CERAMICS Ceramics - White pottery - Definition - Manufacture of white pottery - Uses - Definition of glazing - Purpose - Methods of glazing - Salt glazing - liquid glazing.	4
	5.3 ABRASIVES Definition - Classification - Hardness in Moh's scale - Natural abrasives - Diamond, corundum, emery and garnet - Synthetic abrasives - Carborundum - Boron carbide - Manufacture - Properties and uses.	4
	5.4 LUBRICANTS Definition - Characteristics of lubricant - Types of lubricants - Solid, semi-solid and liquid lubricants.	3

Reference Books:

1. Introduction to Engineering Chemistry, Shradha Sinha, S. S Dara & Sudha Jain, S. Chand Publishers, 2004.
2. Engineering Chemistry, S S Dara, Sudha Jain & Shradha Sinha, S. Chand Publishers 2005.
3. A Textbook of Engineering Chemistry, Dr. Uday Kumar, 2013.
4. Chemistry - Higher Secondary - 1st and 2nd year, Vol. I & II, Tamil Nadu Text Book Corporation, 2018.
5. Engineering Chemistry Fundamentals and Applications - Shikha Agarwal, Cambridge University Press, 2019.
6. Electrochemistry and Corrosion Science - Nestor Perez.

Question Paper Pattern: General Pattern

6015 ENGINEERING GRAPHICS - I

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6015 ENGINEERING GRAPHICS - I			Internal Assessment	External Exam*	Total	
	6 Hrs	96 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Note: While practicing, usage of drawing instruments like drawing board, mini drafter, compass, divider, drawing clips, H, 2H and HB grade drawing pencils, eraser etc., are mandatory for class work and examinations. Size of drawing sheet recommended: A2 size (420 x 594 mm).Use both sides of drawing sheets for practice.

Unit	Name of the Topics	Hrs
I	**DRAWING OFFICE PRACTICE AND DIMENSIONING** **1.1 DRAWING OFFICE PRACTICE** Importance of engineering drawing as a graphic communication - drawing practice as per BIS code - drawing instruments: drawing board, mini drafter, compass, divider, protractor, drawing sheets, drawing pencils, set squares etc., - title block - layout and folding of drawing sheets. Lettering and numbering as per BIS - importance of legible lettering and numbering - single stroke letters - upper case and lower case letters - slanting / inclind letters - general procedures for lettering and numbering - height of letters - guidelines - practices. Scales - full size scale, reducing scale & enlarging scales (Description only).	6
	1.2 DIMENSIONING Dimensioning - need for dimensioning - dimensioning terms and notations as per BIS - dimension line, extension line and leader line - dimensioning systems - methods of placement of dimensions - uni-directional and aligned systems - important dimensioning rules - dimensioning of common features - diameters, radii, holes, chamfers - addition of letters and symbols - parallel, chain and progressive dimensioning - practice of dimensioning the given drawing as per BIS code (one view of the object).	13
II	**GEOMETRIC CONSTRUCTIONS AND CONSTRUCTION OF CONICS** **2.1 GEOMETRIC CONSTRUCTIONS** Bisect a straight line - bisect an arc - bisect an angle - divide a straight line into any number of equal parts - divide the circle into number of equal divisions - construct an arc touching 2 lines at any angle - construct an arc touching 2 arcs.	6
	2.2 CONSTRUCTION OF CONICS Conic sections - definition of locus, focus, directrix, axis, vertex and eccentricity - practical applications of ellipse, parabola and hyperbola.	13

	Ellipse: Construction of ellipse by concentric circle method, rectangular method when major and minor axis are given and eccentricity method when focus and directrix are given - exercises in practical applications. Parabola: Construction of parabola by rectangular method, parallelogram method when major and minor axis are given and eccentricity method when focus and directrix are given - exercises in practical applications. Hyperbola: Construction of hyperbola by eccentricity method when focus and directrix are given - exercises in practical applications.	
III	**PROJECTION OF POINTS & STRAIGHT LINES AND CONSTRUCTION OF SPECIAL CURVES** **3.1 PROJECTION OF POINTS AND STRAIGHT LINES** Projection of points - position of a point on four quadrants and on the reference planes - system of notation - Place a point on four quadrants with different distances - exercises. Projection of straight lines - line in the first quadrant and on the reference planes - parallel to one plane and perpendicular to other plane - inclined to one plane and parallel to the other plane - inclined to both the planes - simple exercises.	**11**
	3.2 CONSTRUCTION OF SPECIAL CURVES Definition and construction of cycloid - epicycloid - hypocycloid - involute of a circle - Archimedean spiral for one revolution - helix - practical applications - exercises.	**8**
IV	**ORTHOGRAPHIC PROJECTIONS** **FIRST ANGLE AND THIRD ANGLE PROJECTION: SIMPLE COMPONENTS** Introduction - projection terms - orthographic projection - planes of projection - principal orthographic views - designation of views - four quadrants - first angle projection - third angle projection - symbols and arrangement of views for first angle and third angle projections - comparison - Simple exercises in first angle projection with min. 2 views of simple components (Without curves & circles). **FIRST ANGLE PROJECTIONS ONLY:** **ENGINEERING COMPONENTS**	**11**
	Draw the projections of the simple engineering components using first angle projection - exercises in drawing orthographic views - three views - front view, top view and right / left side views. (For Exam any two views can be asked.)	**21**

Reference Books:
1. Bhatt N.D, "Engineering Drawing", Charotar Publishing House Pvt. Ltd.
2. Gill P.S, "Engineering drawing", S.K.Kataria & Sons.
3. Gopalakrishna.K.R., "Engineering Drawing", (Vol 1 & 2 combined), Subhas Publications.
4. Venugopal.K, Prabhu Raja V, "Engineering Graphics", New Age International Publishers.
5. Natarajan K V "A Text Book of Engineering Drawing and Graphics" Publisher: N Dhanalakshmi.
6. Shah M B, Rana B C, "Engineering Drawing", Pearson.
7. Basant Agrawal, Agrawal C M "Engineering Drawing", McGraw hill HED.
8. Parkinson A C, "First Year Engineering Drawing", Sir Isaac Pitman & Sons Ltd.
9.Thomas E. French, Charles J. Vierck, "The Fundamentals of Engineering Drawing", McGraw Hill.

QUESTION PAPER PATTERN

PART – A (4 x 5 = 20)

Note: Five questions will be asked (Sl. No: 1 to 5). Answer any four questions.
Each question carries five marks.
Minimum one question should be asked from each unit first chapter.
(Chapters: 1.1, 2.1, 3.1, 4.1)

PART – B (4 x 20 = 80)

Note: Six questions will be asked (Sl. No: 6 to11). Answer any four questions.
Each question carries twenty marks.
Minimum one question should be asked from each unit second chapter. (Chapters: 1.2, 2.2, 3.2, 4.2)

Internal Assessment Marks:

Class work assignment drawings	10
Average of two continuous assessment tests	05
Model examination	05
Attendance	05
Total	**25**

6016 ENGINEERING PHYSICS PRACTICAL - I

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6016 ENGINEERING PHYSICS PRACTICAL - I	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	2 Hrs	32 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

LIST OF EXPERIMENTS WITH OBJECTIVES:

1. SCREW GAUGE - To measure the thickness of the given irregular glass plate using screw gauge and to determine the area of the glass plate using a graph sheet and to calculate the volume of the glass plate.
2. VERNIER CALIPER - To measure the length, inner diameter and outer diameter of the given hollow cylinder using Vernier caliper and to calculate the volume of the hollow cylinder.
3. VERIFICATION OF PARALLELOGRAM LAW OF FORCES
To verify Parallelogram law of forces using Concurrent forces apparatus.
4. VERIFICATION OF LAMI'S THEOREM - To verify Lami's theorem using Concurrent forces apparatus.
5. SIMPLE PENDULUM - To determine the acceleration due to gravity using simple pendulum apparatus.
6. TORSION PENDULUM - To determine the moment of inertia of the disc and rigidity modulus of the given wire using torsion pendulum.
7. STOKE'S METHOD = To determine the coefficient of viscosity of high viscous liquid by Stokes method.
8. SURFACE TENSION - To determine the surface tension of water by capillary rise method.
9. DEFLECTION MAGNETOMETER - To compare the magnetic moments of the given two bar magnets using deflection magnetometer in tan A position by equal distance method.
10. SONOMETER - To determine the frequency of the given tuning fork using sonometer.

QUESTION PAPER PATTERN

Answer any one of the above experiment chosen by random method. The marks will be awarded as per the scheme of valuation given below.

SCHEME OF VALUATION

S. No	Category	Marks
1	Formula and diagram	20
2	Tabulation	10
3	Observation	40
4	Calculation	15
5	Result	10
6	Viva voce	05
	Total	**100**

6017 ENGINEERING CHEMISTRY PRACTICAL - I

SUBJECT	INSTRUCTION		EXAMINATION			
6017 ENGINEERING CHEMISTRY PRACTICAL - I	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	2 Hrs	32 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

VOLUMETRIC ANALYSIS EXPERIMENTS:

Acidimetry and Alkalimetry:
1. Estimation of sulphuric acid using a standard solution of hydrochloric acid and sodium hydroxide as link solution - phenolphthalein indicator.
2. Estimation of sodium hydroxide using standard solution of sodium carbonate using sulphuric acid as a link solution - methyl orange indicator.
3. Comparison of strength of two hydrochloric acid solutions using a link solution of sodium hydroxide - phenolphthalein indicator.
4. Comparison of strength of two sodium hydroxide solutions using Oxalic acid link solution phenolphthalein indicator.

Permanganametry:
5. Estimation of Mohr's salt solution using standard solution of ferrous sulphate and link solution of potassium permanganate.
6. Estimation of ferrous sulphate using standard solution of Mohr's salt solution and link solution of potassium permanganate.
7. Comparison of two Mohr's salt solutions with a link solution of potassium permanganate.
8. Comparison of two potassium permanganate solutions with a link solution of ferrous sulphate.

QUESTION PAPER PATTERN

Answer any one of the above experiment chosen by random method. The marks will be awarded as per the scheme of valuation given below.

SCHEME OF VALUATION

Sl. No	Category	Marks
1	Short procedure	10
2	Titration I	35
3	Titration II	35
4	Calculations (3 x 5)	15
5	Viva Voce	05
	Total	**100**

Titration value accuracy for Titration I and II:

Accuracy	Marks
±0.2ml	**35**
Above ±0.2 ml to ±0.4 ml	**30**
Above ±0.4 ml to ±0.6 ml	**25**
Above ±0.6 ml	**10**

6018 WORKSHOP PRACTICAL - I

SUBJECT	INSTRUCTION		EXAMINATION			
6018M WORKSHOP PRACTICAL - I (For DME)	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	3 Hrs	48 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

I. FITTING

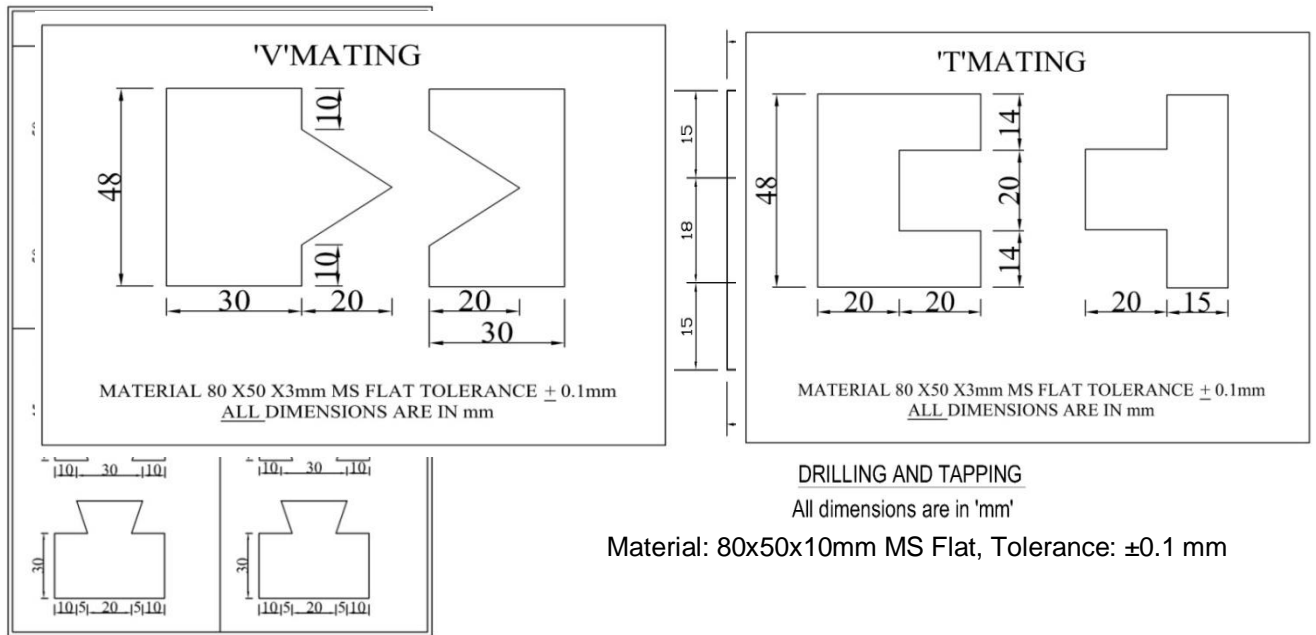Introduction of fitting tools   04 Hrs
Exercises: **12 Hrs**
1. 'V' Mating   2. 'T' Mating   3. Dovetail Mating   4. Drilling & Tapping

'V'MATING

MATERIAL 80 X50 X3mm MS FLAT TOLERANCE ± 0.1mm
ALL DIMENSIONS ARE IN mm

'T'MATING

MATERIAL 80 X50 X3mm MS FLAT TOLERANCE ± 0.1mm
ALL DIMENSIONS ARE IN mm

DRILLING AND TAPPING
All dimensions are in 'mm'
Material: 80x50x10mm MS Flat, Tolerance: ±0.1 mm

Raw material: Use 3 mm thick MS flat for filing and 10 mm MS flat for drilling & tapping.

II. WIRING
Introduction of Wiring Tools   04 Hrs
Exercises: **12 Hrs**
1. One LED lamp controlled by one switch.
2. Two LED lamps controlled by one-way switch in series connection.
3. Two LED lamps controlled by one-way switch in parallel connection.
4. Draw the circuit and execute the Stair case wiring.

III. CARPENTRY
Introduction of Carpentry tools   04 Hrs
Exercises: **12 Hrs**
 1. Planning & check up   2. Cross lap joint   3. Mortise and Tenon joint   4. Dovetail joint
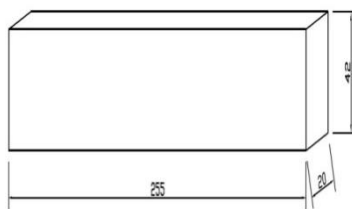
PLANNING AND CHECKING
All dimensions are in 'mm', Size 260x55x25 mm
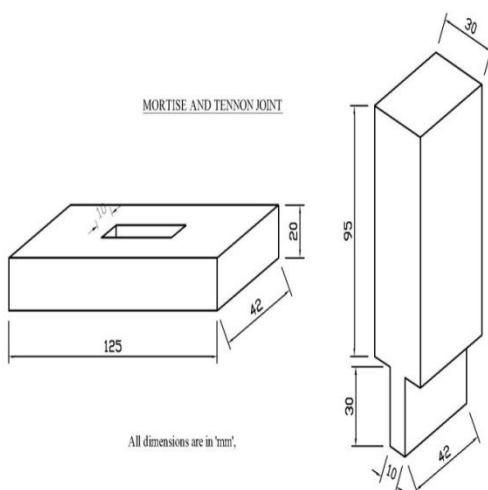
MORTISE AND TENNON JOINT

All dimensions are in 'mm'.
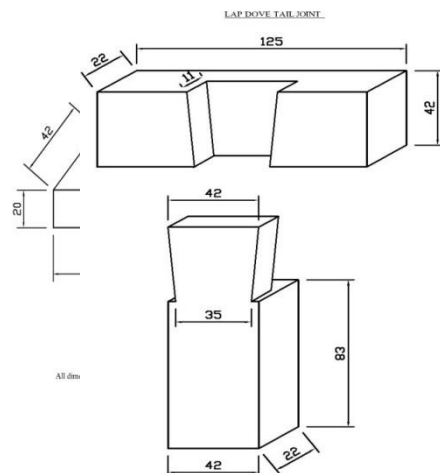
LAP DOVE TAIL JOINT

All dim

21

QUESTION PAPER PATTERN

Fitting Exercise	50 marks
Wiring or Carpentry (Any one) Exercise	45 marks
Viva voce	05 marks
Total	**100 marks**

6001 COMMUNICATION SKILL PRACTICAL

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6001 COMMUNICATION SKILL PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	2 Hrs	32 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**LISTENING SKILL** Listening to speeches by Great speakers / TV News (Assessmentthrough note taking) Listening to short stories (Assessment by vocabulary check) Listening to Indian / British / American English (Assessmentby cloze)	10
II	**READING SKILL** Stress & Intonation Tongue twisters / Tongue modulators frequently Mispronounced words Reading Newspaper - (Skimming & Scanning)	6
III	**SPEAKING SKILL** Polite expressions (Greeting, Requesting, Thanking, Apologizing,Opinions, Suggestions) Introducing Yourself / Friends / Family Recite - quotes of Leaders / Scholars / Scientists Face to face conversation	10
IV	**WRITING SKILL** Thought fillers Completing an Incomplete story How to prepare PPT Non-verbal communication	6

Note:
1. The students should be given proper practice in all the exercises. All theexercises should be completed before the examinations.
2. The students should maintain a record note book. The record note book should be submitted during the semester practical examinations.

PART A - LISTENING (No. of Exercises: 3, Duration: 45 min.)

Exercise	Particulars
1	The examiner shall play either the audio of the speech of a Great speaker or that of TV news running from 3 to 5 min. The audio can be played twice. The candidates may be given 10 minutes to take notes as directed in the question paper.

2	A short story selected by the external examiner shall be played only once without transcript. The objective of this exercise is to test the listening ability of the candidate and therefore questions should be framed accordingly in the pattern of question and answer. The time to complete this exercise is 5 minutes.
3	Any one of the audios (British English, American English or Indian English) may be selected by the external examiner and the same shall be played only once. Maximum of 5 questions for filling in the blanks may be given and the candidates may be provided maximum of 10 minutes to answer the questions.

This part shall be completed within 45 min. including the time used for playinglistening audios.

PART B - READING (No. of Exercises: 3, Duration: 45 min.)

Each batch may be divided into two groups. Both examiners may engage all the students.

Exercise	Particulars
1	Read out the tongue twister.
2	A passage from newspaper can be given for reading.
3	Pronounce the words correctly.

This part shall be completed within 45 minutes.

PART C - SPEAKING (No. of Exercises: 4, Duration: 45 min.)

Divide the students to make it convenient for conversations in English by a pair. Both examiners can handle.

Exercise	Particulars
1	Polite expressions for the context provided.
2	Self-introduction for the interview
3	Any five quotes can be recited from the given list of quotes of Leaders, Scholars and Scientists.
4	The candidates have to speak as directed by the concerned examiner. All the questions are mandatory.

This part shall be completed within 45 minutes.

PART D - WRITING (No. of Exercises: 3, Duration: 45 min.)

All students should appear for this part.

Exercise	Particulars
1	Five questions with blanks shall be asked based on a list of 25 frequently used thought fillers already trained during lab classes.
2	Shall consist of an unknown incomplete story providing scope for further development and application of imagination. (Minimum 3 lines for completion with suitable title and moral)
3	Questions can be taken from a list of fifteen important questions covering the core areas of non-verbal communication. (Five out of eight questions to be answered)

This part shall be completed within 30 minutes.

ALLOCATION OF MARKS

	Description	Marks
A	Listening	30
B	Reading	20
C	Speaking	30
D	Writing	20
	Total	**100**

Guidelines for Conduct of Practical Classes and Writing Record Note:

There are 13 experiments in total equally distributed to each skill as follows:

Sl. No	Name of the exercise	Min. Exercises to be practiced /

		written in Record Note
	Listening Skill	
1	Listening to Speeches by Great Speakers/ TV News	Each One exercise
2	Listening to Short Stories	Minimum of two exercises
3	Listening to Indian / British / American English	Minimum of two exercises
	Reading Skill	
4	Reading Tongue Twisters	A list of 25 tongue twisters
5	Reading English Newspapers	Minimum 2 passages from any English Newspaper
6	Frequently mispronounced words	List of 25 words
	Speaking Skill	
7	Making Polite Expressions	Polite expressions - Greeting, Requesting, Thanking, Apologizing, Opinions, Suggestions
8	Introducing oneself / friends/family	Minimum two exercises for introducing oneself and introducing others
9	Reciting quotes	Quotes of Leaders / Scholars / Scientists (List of 25 quotes)
10	Face to face conversation	Minimum two exercises
	Writing Skill	
11	Use of Thought Fillers	A list of 25 frequently used thought fillers
12	Completing an Incomplete Story	Minimum of two exercises. (conclusion - minimum 3 lines, title & moral)
13	Non-Verbal Communication	A list of 10 questions and answers relating to non- verbal communication.

Notes:

1. Each experiment shall be awarded 20 marks and the total marks secured in all experiments shall be averaged to 20 marks.
2. Attendance mark shall be calculated for 5 marks as per the given norms.
3. Total internal mark is 25 (Record 20 marks + Attendance 5 marks).
4. Observation note is not applicable for this practical.
5. Listening skill exercises: For each exercise under Listening Skill, minimum exercise should be provided for practice and should be recorded in the record note.(as per the tabular column)

Open sources available online on the sites such as
   www.youtube.com,
   www.letstalk.co.in,
   http://www.bbc.co.uk/learningenglish/english/features/6-minute-english, and
   https://esl-lab.com/, can be utilized for sessions on improving listening skill.

Note:
Since there is no observation note for English Communication Practical, the worksheets practiced by the students should be preserved along with the Record Note.

SECOND SEMESTER

6021 COMMUNICATIVE ENGLISH - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6021 COMMUNICATIVE ENGLISH - II	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**Functional Grammar and Usage** Application of Modal Verbs Negative Formation (No, Never, Nothing, Hardly, Seldom, No longer,None, Nowhere, Neither . . . nor) Use of Subordinating ConjunctionsUse of Conditionals Reported Speech (Dialogue to Indirect Speech)Punctuation Synthesis of three or more sentences	13
II	**English for Enrichment** The Language Game: Unscramble Phrases (Noun, Verb, Prepositional Phrases, etc.)Cause and Effect Writing Suitable Responses to the Given Questions Giving Instructions Character sketch	11
III	**Situational English** Email for Official CommunicationSocial Media Language Reacting to Situations Correction of Sentences Proverbs for Everyday Situations	11
IV	**Creative English** The Language Game: Word Puzzle GridNotice Writing for the Given Situations Slogan Writing Technical Words Infographics Comprehension Story completion	11
V	**English for Scholarly Presentation / Fluency** "The Lost Child" by Mulk Raj Anand "My Vision for India" by Abdul Kalam "From Lover's Gift" by Rabindranath Tagore"The Flower" by Tennyson	11

Reference Books:

Glossaries

https://www.engineering-dictionary.com/ https://techterms.com/definition/ http://dictionary.tamilcube.com/
https://www.lexilogos.com/english/tamil_dictionary.htm

Grammar
1. Just Enough English Grammar Illustrated, Gabriele Stobbe, McGraw-HillOsborne Media, 2008
2. Visual Guide to Grammar and Punctuation, DK Publishing, 2017
3. English Grammar in Use, Raymond Murphy, Cambridge University Press, 2019
4. Intermediate English Grammar, Raymond Murphy, Cambridge University Press,Second Edition.
5. Essential English Grammar, Raymond Murphy, Cambridge University Press,New edition.

Enrichment of Study
1. Enrich Your Vocabulary: Vocabulary for General, Placement & Competitive Exams by Edin Brow

Motivation
1. An Autobiography; Or, The Story of My Experiments with Truth, Mahatma Gandhi, Penguin Books, 2001
2. You Can Win, Shiv Khera, New Dawn Press, 2004
3. Chicken Soup for the Soul, Jack Canfield, Mark Victor Hansen, 2001
4. How to Win Friends and Influence People by Dale Carnegie

QUESTION PAPER PATTERN

Continuous Assessment Test - I:

Time: 2 Hrs.   Max. Marks: 50

Sl. No	Questions	Marks
1	Answer any TEN out of 15 questions	10 x 5 = 50

Continuous Assessment Test - II:

Time: 2 Hrs.   Max. Marks: 50

Sl. No	Questions	Marks
1	Answer any TEN questions	10 x 5 = 50

Model Examination / Autonomous Examination

Time: 3 Hrs.   Max. Marks: 100

Sl. No	Questions	Portions	Marks
1	Answer any TEN out of 12 questions	Unit I & II - Grammar items	10 x 4 = 40
2	Answer any FOUR out of 6 questions	Unit III - Composition items	4 x 5 = 20
3	Answer any FOUR out of 6 questions	Unit IV - Composition items	4 x 5 = 20
4	Answer any FOUR out of 6 questions	Unit V - Prose & Poetry	4 x 5 = 20
		TOTAL	**100**

6022 ENGINEERING MATHEMATICS - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6022 ENGINEERING MATHEMATICS - II	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	5 Hrs	80 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**ANALYTICAL GEOMETRY**	
	ANALYTICAL GEOMETRY Circles - General equation of a circle - Family of circles - Concentric circles - Orthogonal circles (condition only) - contact of circles - simple problems.	**6**
	CONICS Definition of a conic, Focus, Directrix and Eccentricity - General equation of a conic $ax^2 + 2hxy + by^2 + 2gx + 2fy + c = 0$.(Statement only) - Condition for conic For circle $a = b$ and $h = 0$ For pair of straight line : $\begin{vmatrix} a & h & g \\ h & b & f \\ g & f & c \end{vmatrix} = 0$ For parabola : $h^2 - ab = 0$ For ellipse : $h^2 - ab < 0$ and (v) For hyperbola : $h^2 - ab > 0$ - simple problems.	**8**
II	**VECTOR ALGEBRA - I** **2.1 VECTOR – INTRODUCTION** Definition of vector - types, addition, subtraction and scalar multiplication of vector, properties of addition and subtraction - Position vector - Resolution of vector in three dimensions - Distance between two points - Direction cosines and direction ratios - simple problems.	**7**
	2.2 PRODUCT OF TWO VECTORS Scalar product - Vector product - condition for parallel and perpendicular vectors - properties - angle between two vectors - Unit vector perpendicular to	**7**

	two vectors - Application of Scalar and Vector product - simple problems.	
	INTEGRAL CALCULUS - I	
	3.1 INTEGRATION - DECOMPOSITON METHOD	5
	Historical approach for integration - Anti derivative - Definition of the integral as an anti-derivative - Fundamental rules for integration - Integration using decomposition method - simple problems based on Engineering applications.	
	3.2 METHODS OF INTEGRATION - INTEGRATION BY SUBSTITUION	
III	Integrals of the form $\int [f(x)]^n f'(x)dx$, Where $n \neq -1$ $\int \frac{f'(x)}{f(x)}dx$ and	5
	$\int F[f(x)]f'(x)dx$ - simple problems.	
	3.3 STANDARD INTEGRALS	
	Integrals of the form, $\int \frac{dx}{a^2 \pm x^2}$, $\int \frac{dx}{x^2 - a^2}$, $\int \frac{dx}{\sqrt{a^2 - x^2}}$, $\int \sqrt{a^2 - x^2}dx$, $\int \sqrt{x^2 \pm a^2}dx$ - simple problems.	5
	INTEGRAL CALCULUS - II	
	4.1 METHODS OF INTEGRATION - INTEGRATION BY PARTS	4
	Integrals of the form $\int x\sin nxdx, \int x\cos nxdx, \int xe^{nx}dx, \int x^n \log xdx,$ and $\int \log xdx$ - simple problems.	
IV	**4.2 BERNOULLI'S FORMULA**	5
	Evaluation for the integrals $\int x^m \sin nxdx, \int x^m \cos nxdx , \int x^m e^{nx}dx,$ where $m \leq 3$ using Bernoulli's formula - simple problems.	
	4.3 DEFINITE INTEGRALS	6
	Definition of definite integral - Properties of definite integrals - simple problems.	
	APPLICATIONS OF INTEGRATION	
	5.1 AREA AND VOLUME	5
	Area and volume - Area of circle - Volume of sphere and cone - simple problems.	
	5.2 FIRST ORDER DIFFERENTIAL EQUATIONS	
	Solution of first order variable separable type differential equations - Solution of linear type differential equations - simple problems.	5
V	**5.3 SECOND ORDER DIFFERENTIAL EQUATIONS**	
	Solution of second order differential equations with constant co-efficients	5
	$(i) \ a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = 0$	
	$(ii) \ a\frac{d^2y}{dx^2} + b\frac{dy}{dx} + cy = f(x), \ where \ f(x) = e^{ax}$ - simple problems.	

Reference Books:

1. Higher Secondary +1 Mathematics volume I & II. Tamil Nadu Text Book Corporation.
2. Higher Secondary +2 Mathematics Volume I & II. Tamil Nadu Text Book Corporation.
3. Engineering Mathematics V. Sundaram, R. Balasubramanian.
4. Engineering Mathematics - I C.B.Gupta ,A.K.Malik, New age international Pub., 1st ed, - 2008.
5. Differential Calculus S. Balachandra Rao, CK Shantha New age Publishers
6. Probability Theory and Stochastic Process B.Prabhakara Rao, TSR Murthy, BS Publishers.
7. Vectors and Geometry GS. Pandey, RR Sharma, New age international publishers.
8. Engineering Mathematics - I Guruprasad Samanta, New age int. publishers, 2nd edition 2015
9. Engineering Mathematics Reena Garg, Khanna pub. house, New Delhi, Revised edn. -2018.
10. Engineering Mathematics Volume I P. Kandasamy and K. Thilagavathy, S. Chand & Co. Ltd.

QUESTION PAPER PATTERN: General Pattern

6023 ENGINEERING PHYSICS - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION	
6023	Hrs / Week	Hrs / Sem	Marks	Duration

ENGINEERING PHYSICS - II			Internal Assessment	External Exam*	Total	
	5 Hrs	80 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**HEAT** **1.1 TRANSFER OF HEAT** Concept of Heat and temperature - Celsius, Fahrenheit and Kelvin scales of temperature - Conduction, convection and radiation - Definitions and explanations - Good and poor thermal conductors - Examples - Coefficient of thermal conductivity - Definition and its SI unit - Properties of thermal radiation - Heat conversions.	5
	1.2 KINETIC THEORY OF GASES Postulates of kinetic theory of gases - Mean square velocity and Root Mean Square (RMS) velocity of molecules - Definitions and expressions - Expression for the pressure of a gas on the basis of postulates of kinetic theory of gases - Relation between pressure and kinetic energy of the gas - Relation between kinetic energy and absolute temperature of the gas - Simple problems based on the expression for the pressure of a gas.	5
	1.3 SPECIFIC HEAT CAPACITY Specific heat capacity of a substance (solids and liquids) - Definition - Specific heat capacity of a gas at constant pressure - Specific heat capacity of a gas at constant volume - Ratio of specific heat capacities - Explanation for C_p is greater than C_v - Derivation of Mayer's relation - Calculation of Universal gas constant R from the gas equation (PV = RT) - Simple problems based on Mayer's relation.	5
II	**THERMODYNAMICS, LIQUEFACTION OF GASES AND NON-CONVENTIONAL ENERGY** **2.1 THERMODYNAMICS** Concept of internal energy - First law of thermodynamics - Statement - Concept of indicator diagram (PV Diagram) - Isothermal and adiabatic change - Explanation - Equation for isothermal and adiabatic change (No derivation) - Simple problems based on equations $P_1V_1 = P_2V_2$ and $P_1V_1^\gamma = P_2V_2^\gamma$ - Second law of thermodynamics - Clausius statement and Kelvin's statement - Working of Carnot engine with PV diagram - Efficiency of Carnot engine - Applications of heat and thermodynamics.	6
	2.2 LIQUEFACTION OF GASES Difference between gas and vapour - Critical temperature, critical pressure and critical volume - Definitions - Principle used in Cascade process - Cascade process of liquefaction of oxygen - Disadvantages of Cascade process - Joule Thomson effect - Temperature of inversion - Liquefaction of air by Linde's process.	4
	2.3 NON-CONVENTIONAL ENERGY Introduction - Non-renewable and Renewable (Alternate) energy sources - Examples - Solar energy - Wind energy - Tidal energy – Advantages and disadvantages of renewable energy.	4
III	**LIGHT** **3.1 OPTICS** Reflection - Laws of reflection - Refraction - Laws of refraction - Refractive index of a medium - Definitions - Derivation of refractive index of glass prism using minimum deviation - Spectrometer - Experimental determination of refractive index using spectrometer - Phenomenon of total internal reflection - Applications of total internal reflection - Fiber optics - Introduction - Optical Fiber Cable as a wave guide - Advantages of OFC - Problems based on refractive index.	6
	3.2 LASER LASER - Characteristics of LASER - Principle of LASER - Spontaneous emission	4

	- Stimulated emission - Population inversion - Ruby Laser - Construction and working - Uses of LASER.	
	3.3 REMOTE SENSING	
	Introduction - Active and passive remote sensing - Explanation and examples - Components of remote sensing - Data acquisition and data analysis - Reference data - RADAR - Principle and working with block diagram.	4
IV	**ELECTRICITY**	
	4.1 ELECTRICAL CIRCUITS	5
	Ohm's law - Laws of resistances - Resistivity, conductivity, super conductivity and Meissner effect - Definitions - Kirchhoff's current and voltage laws - Condition for balancing the Wheatstone's bridge - Simple problems based on expression for resistivity - Capacitance of a capacitor - Definition - 'farad' - Definition - Expressions for effective capacitance when capacitors are connected in series and in parallel - Simple problems based on effective capacitance of capacitors connected in series and in parallel - Applications of capacitors.	
	4.2 EFFECTS OF CURRENT	
	Joule's law of heating - Experimental determination of specific heat capacity of a liquid using Joule's calorimeter - Faraday's laws on electrolysis - Electro chemical equivalent (e.c.e) of an element - Definition - Experimental determination of e.c.e. of copper - Simple problems based on expressions for e.c.e - Applications of heating effect of electric current.	4
	4.3 ELECTROMAGNETIC INDUCTION	
	Introduction - Magnetic flux - Faraday's experiments on electromagnetic induction - Lenz's law - Fleming's right hand rule - Self induction and mutual induction (definitions) - Applications of electromagnetic induction.	2
	4.4 MEASURING INSTRUMENTS	
	Expression for the force acting on a current carrying straight conductor placed in a uniform magnetic field - Fleming's Left Hand rule - Expression for the torque experienced by a rectangular current carrying coil placed inside a uniform magnetic field - Working of a moving coil galvanometer and its merits - Conversion of galvanometer into an ammeter and voltmeter - Simple problems based on conversion of galvanometer into ammeter and voltmeter.	4
V	**ELECTRONICS**	
	5.1 SEMICONDUCTORS	
	Introduction - Energy bands in solids - Energy band diagram of good conductors, insulators and semiconductors - Concept of Fermi level - Types of semiconductors - Intrinsic semiconductors - Concept of holes - Doping - Extrinsic semiconductors - P type and N type semiconductors.	5
	5.2 DIODES AND TRANSISTORS	
	PN junction diode - Forward bias and reverse bias - Rectification action of diode - Working of full wave bridge rectifier using PN junction diodes - PNP and NPN transistors - Three different configurations - Working of NPN and PNP transistor in common base configuration.	5
	5.3 DIGITAL ELECTRONICS	
	Digital electronics - Introduction - Logic levels - Basic logic gates - OR, AND, NOT gates - Universal logic gates - NAND and NOR gates - Symbolic representation, Boolean expression and truth table for all the above logic gates - Integrated circuits - Levels of integration - SSI, MSI, LSI and VLSI - Advantages of ICs - Applications of transistors, gates and ICs.	5

Reference Books:
1. Fundamentals of Physics - Halliday & Resnick - Wiley India Pvt. Ltd. - Sixth Edition
2. Fundamentals of Magnetism and Electricity - D.N. Vasudeva - S. Chand Publishing - 5th Ed.
3. Physics for Higher Secondary - First & Second year - Volume I & II - Tamilnadu Textbook and Educational Services Corporation 2018
4. Non-conventional energy sources - G.D. Rai - Khanna Publishers - Sixth Edition
5. Textbook of Remote Sensing &Geographical Inforn. Systems-M.Anji Reddy BS Publications–4th Edition.

<div align="center">QUESTION PAPER PATTERN: General Pattern</div>

6024 ENGINEERING CHEMISTRY - II

<div align="right">No. of weeks per semester: 16</div>

SUBJECT	INSTRUCTION		EXAMINATION			
6024 ENGINEERING CHEMISTRY - II	Hrs / Week	Hrs / Sem	Marks			Duration
			Internal Assessment	External Exam*	Total	
	5 Hrs	80 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	**ENVIRONMENTAL CHEMISTRY** **1.1 AIR POLLUTION** Pollution and air pollution – Definition - Air pollutants (SO_2, H_2S, HF, CO and dust) - Harmful effects - Formation of acid rain - Harmful effects - Green house effect - Causes - Global warming - Harmful effects - Ozone layer - Importance - Causes for depletion of ozone layer (No equations) - Harmful effects of Ozone layer depletion - Control of air pollution.	6
	1.2 WATER POLLUTION Causes of water pollution - (Sewage, Effluents, Algae and Micro-organisms) - Sewage - Definition - Problems and disposal of sewage - Industrial effluents - Harmful effects of heavy metal ions (Lead, Cadmium, Zinc and Copper) - Treatment of effluents - Eutrophication - Definition and harmful effects.	5
	1.3 SOLID WASTE MANAGEMENT Solid waste - Definition - Problems - Types of solid waste - Methods of disposal - Land fill and incineration. Recycling - Definition - Examples – Adv. of recycling (Basic concepts).	3
	1.4 GREEN CHEMISTRY Definition - Goals of Green Chemistry (Basic concepts)	1
II	**POLYMER CHEMISTRY** **2.1 PLASTICS** Plastics - Definition - Types of polymerization - Addition polymerization - Formation of polythene - Condensation polymerization - Formation of Bakelite - Types of plastics - Thermoplastics and thermosetting plastics – Differences - Mechanical properties of plastics - Advantages of plastics over traditional materials (wood and metal) - Specific uses of some plastics (Bakelite, PVC, Nylon & Urea-formaldehyde) - Polymers in surgery - Biomaterials - Definition - Biomedical uses of polyurethane, PVC, Polypropylene and Polyethylene.	8
	2.2 RUBBER Rubber - Definition - Preparation of natural rubber from latex - Defects of natural rubber - Compounding of rubber - Ingredients and their functions - Vulcanization of rubber - Definition and purpose - Synthetic rubber - Buna-S, Thiokal, Neoprene - Reclaimed rubber - Definition - Process - Properties and uses.	6
III	**FUELS, ROCKET PROPELLANTS AND REFRACTORY** **3.1 FUELS** Fuel - Definition - Calorific value of fuels - Classification - Solid fuels - Wood - Coal - Varieties of coal - Composition - Specific uses - Liquid fuels - Refining of petroleum - Fractional distillation - Cracking (concept only) - Liquid hydrogen - Gaseous fuels - Preparation, composition and specific uses of producer gas and water gas - Composition and uses of LPG - Advantages of gaseous fuels - comparison of solid, liquid and gaseous fuels. **3.2 ROCKET PROPELLANTS**	6

		Definition - Characteristics - Classification of propellants - brief account of solid and liquid propellants with example**.	4
		3.3 REFRACTORY	
		Definition - Requirements of a good refractory - Classification - Acidic, basic and neutral refractory - Examples and uses - Uses of fire clay bricks, Alumina bricks and Silica bricks.	4
IV		**METALLURGY, EXTRACTION OF METALS, ALLOYS, LIME AND CEMENT**	
		4.1 METALLURGY	
		General principles of metallurgy - Minerals, ores, gangue, flux, slag - Metallurgical processes - Concentration of the ore (gravity separation, froth floatation process and magnetic separation) - Chemical methods of purifying ore (roasting, calcination, smelting) - Refining - Electrolytic refining, Van Arkel method, Distillation method.	5
		4.2 EXTRACTION OF METALS Extraction & uses of tungsten and titanium.	2
		4.3 ALLOYS	
		Definition - Purpose of alloying - Types - Ferrous alloys - Composition and uses of Stainless steel, Chromium steel and Vanadium steel - Non-ferrous alloys - Composition and uses of Brass, Dutch metal (German silver), Bronze (Gunmetal), Nickel alloys (Nichrome), Aluminium alloys (Duralumin).	4
		4.4 LIME AND CEMENT	
		Lime - raw materials used for lime - Manufacture of hydraulic lime by continuous vertical kiln process - properties - slaking, plasticity and setting. Cement - Definition - Manufacture of portland cement - Wet process - Setting of cement (No equation).	4
V		**CORROSION AND PREVENTION OF CORROSION**	
		5.1 CORROSION	
		Definition - Types of corrosion - Theories of corrosion - Galvanic cell formation theory - Differential aeration theory - Factors influencing the rate of corrosion.	5
		5.2 METHODS OF PREVENTION OF CORROSION	
		Control of environment - Alloying - Surface coatings - Metal coatings - Electroplating, galvanization and tinning - Inorganic coating - Anodisation and phosphate coating - Cathodic protection - Sacrificial anode method and impressed voltage method.	5
		5.3 ORGANIC COATINGS	
		Paint - Definition - Components of paints - Varnish - Definition - Types - Preparation of oil varnish - Differences between paint and varnish - Special paints - Luminescent paint, fire retardant paint, aluminium paint and distemper.	5

Reference Books:
1. Introduction to Engineering Chemistry, Shradha Sinha , S S Dara & SudhaJain, S.Chand Publishers, 2004.
2. Engineering Chemistry, S S Dara, Sudha Jain & Shradha Sinha, S.Chand Publishers,2005.
3. A Textbook of Engineering Chemistry, Dr. Uday Kumar, 2013.
4. Chemistry - Higher Secondary - I & II year, Vol. I & II, Tamil Nadu Text Book Corporation 2018.
5. Engineering Chemistry Fundamentals and Applications, Shikha Agarwal, Cambridge University Press, 2019.
6. Electrochemistry and Corrosion Science, Nestor Perez.
7. Indian Minerals Year book 2011.

QUESTION PAPER PATTERN: General Pattern

6025 ENGINEERING GRAPHICS - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6025 **ENGINEERING GRAPHICS – II**	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	5 Hrs	80 Hrs	**Internal Assessment**	**External Exam***	**Total**	

			25	75	100	3 Hrs
(For DCE and DME)						

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Note: While practicing, usage of drawing instruments like drawing board, mini drafter, compass, divider, drawing clips / cello tape, H, 2H and HB grade drawing pencils, eraser etc., are mandatory for class work and examinations. Size of drawing sheet recommended: A2 size (420 x 594 mm). Use both sides of drawing sheets for practice.

Unit	Name of the Topics	Hrs
I	**CONSTRUCTION OF POLYGONS AND PROJECTION OF PLANES** **1.1 CONSTRUCTION OF POLYGONS** Construction of regular polygon: triangle, square, pentagon and hexagon - various positions - side of the polygon is parallel, perpendicular and inclined to principal planes.	6
	1.2 PROJECTION OF PLANES Projection of planes - rectangle, square, hexagon and circle – plane parallel to HP and perpendicular to VP - plane parallel to VP and perpendicular to HP - plane perpendicular to both HP and VP - plane parallel to both the planes - simple exercises.	9
II	**PROJECTION OF SOLIDS AND SECTION OF SOLIDS** **2.1 PROJECTION OF SOLIDS IN SIMPLE POSITIONS** Introduction - important terms - classification of solids - triangular and hexagonal prisms and pyramids - solids of revolution - cylinder and cone - projection of solids in simple positions - axis parallel to one plane and perpendicular to other plane.	6
	2.2 PROJECTION AND SECTION OF SOLIDS **2.2.1 PROJECTION OF SOLIDS** Position of solid - axis inclined to one plane and parallel to other plane - axis parallel to both planes - simple exercises. **2.2.2 SECTION OF SOLIDS** Need for section view - cutting plane - cutting plane line - representation as per BIS code - Hatching line - true section - section of simple solids - triangular and hexagonal prisms and pyramids, cylinder, cone - position of solids - axis perpendicular to one plane and parallel to other plane - position of cutting planes - cutting plane perpendicular to one plane and parallel to another plane - cutting plane perpendicular to one plane and inclined to another plane - true shape - exercises.	14
III	**DEVELOPMENT OF SURFACES** **3.1 DEVELOPMENT OF REGULAR SOLIDS** Need for preparing development drawing with reference to sheet metal work - procedure for preparing development drawing of prism, pyramid, cylinder and cone - exercises in rectangular, square and hexagonal prisms and pyramids - exercises in regular cylinder and cone.	6
	3.2 DEVELOPMENT OF COMPONENTS Cutting plane - cutting plane line - development of truncated prism and cylinder - frustum of pyramid and cone - development of simple engineering components such as elbow, ducts, lamp shade and funnel.	9
IV	**MISSING VIEWS AND ISOMETRIC PROJECTIONS** **4.1 MISSING VIEWS** Reading a drawing - missing views - visualization - possible view problems - Drawing a missing view or third view (Draw missing view only) - simple exercises.	9
	4.2 ISOMETRIC PROJECTIONS Introduction - isometric view - isometric projection - methods of drawing an isometric view - box method - construction of arcs and circles - four centre method for drawing ellipse - construction of isometric drawing of components	14

| | from the given orthographic views - simple exercises. | |

Reference Books:
1. Bhatt N.D, "Engineering Drawing", Charotar Publishing House Pvt. Ltd.
2. Gill P.S, "Engineering drawing", S.K.Kataria & Sons.
3. Gopalakrishna.K.R., "Engineering Drawing", (Vol 1 & 2 combined), Subhas Publications.
4. Venugopal.K, Prabhu Raja V, "Engineering Graphics", New Age International Publishers.
5. Natarajan K V "A Text Book of Engineering Drawing and Graphics" Publisher: N Dhanalakshmi.
6. Shah M B, Rana B C, "Engineering Drawing", Pearson.
7. Basant Agrawal, Agrawal C M "Engineering Drawing", McGraw hill HED.
8. Parkinson A C, "First Year Engineering Drawing", Sir Isaac Pitman & Sons Ltd.
9.Thomas E. French, Charles J. Vierck, "The Fundamentals of Engineering Drawing", McGraw Hill.

QUESTION PAPER PATTERN

PART – A (4x5 = 20)

Note: Five questions will be asked (Sl. No: 1 to 5). Answer any four questions.
Each question carries five marks.
Minimum one question should be asked from each unit first chapter.
(Chapters: 1.1, 2.1, 3.1, 4.1)

PART – B (4x20 = 80)

Note: Six questions will be asked (Sl. No: 6 to11). Answer any four questions.
Each question carries twenty marks.
Minimum one question should be asked from each unit second chapter. (Chapters: 1.2, 2.2, 3.2, 4.2)

INTERNAL ASSESSMENT

Class work assignment drawings	10
Average of two continuous assessment tests	05
Model examination	05
Attendance	05
Total	**25**

6026 ENGINEERING PHYSICS PRACTICAL - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6026 ENGINEERING PHYSICS PRACTICAL - II	2 Hrs	32 Hrs	Internal Assessment	External Exam*	Total	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

LIST OF EXPERIMENTS WITH OBJECTIVES:
1. SOLAR CELL -   To study the VI characteristics of the given solar cell.
2. REFRACTIVE INDEX -   Determine the refractive index of water using travelling microscope.
3. LAWS OF RESISTANCES - To verify the laws of resistances using Ohm's law.
4. METRE BRIDGE - To determine unknown resistance of the given wire using metre bridge.
5. POTENTIOMETER - To compare the emfs of the given two cells.
6. JOULE'S CALORIMETER - To determine the specific heat capacity of water using Joule's calorimeter.
7. TANGENT GALVANOMETER -   To determine the value of the horizontal component of the earth's magnetic field using tangent galvanometer.
8. PN JUNCTION DIODE -   To study the voltage-current characteristics of the given PN junction diode in forward bias and to find its dynamic forward resistance.
9. TRANSISTOR CHARACTERISTICS -   To study the transfer characteristics of the given NPN transistor in common emitter configuration and to find its current gain.

10. LOGIC GATES - To find the output conditions for different combinations of the input for NOT gate and 2 inputs AND, OR, NAND & NOR logic gates using IC chips.

QUESTION PAPER PATTERN

Answer any one of the above experiment chosen by random method. The marks will be awarded as per the scheme of valuation given below.

SCHEME OF VALUATION

S. No	Category	Marks
1	Formula and diagram	20
2	Tabulation	10
3	Observation	40
4	Calculation	15
5	Result	10
6	Viva voce	05
	Total	**100**

6027 ENGINEERING CHEMISTRY PRACTICAL - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6027 ENGINEERING CHEMISTRY PRACTICAL - II	2 Hrs	32 Hrs	Internal Assessment	External Exam*	Total	
			25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

QUALITATIVE ANALYSIS;

ACID RADICALS: 1. Carbonate 2. Chloride 3. Nitrate 4. Sulphate

BASIC RADICALS:

S.No	Radicals
1	Lead
2	Copper
3	Aluminium
4	Zinc
5	Barium
6	Calcium
7	Magnesium
8	Ammonium

ANALYSIS OF INORGANIC SIMPLE SALT:

Analysis of eight inorganic simple salts containing any one acid radical and basic radical without omitting any of the above mentioned radicals

QUESTION PAPER PATTERN

Answer any one of the above Inorganic simple salt chosen by random method. The marks will be awarded as per the scheme of evaluation.

SCHEME OF VALUATION

Description	Marks

Identification procedure of acid radical with systematic procedure		**45**
Identification procedure of basic radical with systematic procedure		**45**
Viva voce		**10**
Total		**100**
Without systematic procedure		
Identification of acid radical with confirmatory test only		**45**
Identification of basic radical with confirmatory test only		**45**
Mere spotting of acid radical and basic radical (5+5)		**10**
Writing systematic procedure without correct radicals		**20**

6028 BASICS OF INDUSTRIES AND WORKSHOP PRACTICAL - II

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6028 BASICS OF INDUSTRIES AND WORKSHOP PRACTICAL - II	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	Theory *: 2 Practical: 3	80 Hrs	**Internal Assessment**	**External Exam****	**Total**	
			25	75	100	3 Hrs

 * Theory Portion common for all branches.
**** Examination will be conducted for 100 marks (45 Marks Theory and 55 Marks Practical) and the marks obtained will
       be converted into 75 marks.**

BASICS OF INDUSTRIES:

Unit	Name of the Topics	Hrs
I	**BASICS OF INDUSTRIES** Industry - Need of Industrialization - Classification - Factors influences the location of the Industries - Types of Industries: Small scale, Medium scale and Large scale industries - Procedure to start up an Industry. Manufacturing Industry - Overviews - Global manufacture. Engineering Industry: Introduction - Engineering materials – Products of various engineering sectors.	6
II	**INDUSTRIAL SAFETY MEASURES AND MAINTENANCE** Industrial safety - Importance - Safety activities - Safety equipment - Health and safety procedure - Personnel protective devices - Safe working practices - Structural collapse - Safety signs. Accident - Causes - Prevention of accidents - Electric shock- Safety precautions against electric shock - Significance of first aid. Plant Maintenance: Introduction - Objectives - Importance. Maintenance practices: Breakdown maintenance - Preventive maintenance - Scheduled maintenance - Predictive maintenance -Standard data for maintenance. TPM: Introduction - Objectives - Steps of TPM process.	6
III	**QUALITY AND STANDARDS** Definition of quality - Quality control - Quality assurance - Modern management techniques - Just In Time (JIT) - Total Quality Management (TQM) - Introduction - PDSA cycle - Kaizen - TQM Tools -Bench marking - Quality circle - Zero Defect Concept - 5S principle - Sort, Set in order, Shine, Standardise and Sustain - Necessity of 5S - Six Sigma - Essential elements - Methodologies - Six sigma belt - SWOT analysis. BIS for construction - National Building Code - ISO standards - ISI Standards - Intellectual property rights - Engineering Ethics -.Brief description only.	6

IV	**BASICS OF ENGINEERING**	8
	Tolerance - Limits - Deviation - Allowance - Definitions only - Types of tolerances: Unilateral, Bilateral - Fits - Types of fits.	
	Types of structures - List of materials used for building construction - Requirements of water for construction. Mortar: Types and its properties. Concrete: Constituents – Requirements - Types of grouting materials - Types of roofing - Types of foundation - requirements of good foundation - Standard sizes of doors and windows. Weathering course: Purpose - Materials required. Earthquake: Types of earth quake and its remedial measures. Rain water harvesting - Types - Importance.	
	EMF - Current - Potential difference - Electric power - Definitions only. Wiring - Types of wires - Internal wiring - Cleat wiring - Surface conduit wiring - Concealed conduit.	
V	**INDUSTRY 4.0**	6
	Industrial revolution - Definition – History - Industry 4.0 - Definition - Design principles and goals - Industry 4.0 technologies - Big data - Cloud computing - Internet of Things (IoT) - Simulation - Autonomous robots - Augmented reality - Cyber security - System integration - Additive manufacturing.	
	Evolution of Industry 4.0 - Global readiness - Global trend - Initiative by Industries and Government - Importance of Industry 4.0.	

Reference Books:

1. Industrial Organisation and Engineering Economics - "T.R.Banga, S.C. Sharma"-Khanna Publishers
2. Industrial Engineering and Management "O.P. Khana" - Dhanbat Rai Publications.
3. Machine Drawing - K.L.Narayana, P.Kannaiah, K.Venkata reddy - New Age International Publishers.
4. Elements of Civil Engineering - Bhavikatti
5. A Text Book of Electrical Technology - B.L. Theraja, A.K. Theraja - S.Chand & Company Ltd.
6. Testing, Commissioning, Operation and Maintenance of Electrical Equip.- S.Rao - Khanna Publishers.
7. A Course in Electrical Power by Soni & Gupta - Dhanbat Rai & Sons, New Delhi.

INTERNAL ASSESSMENT

Assignment (Theory portion)*	10 marks
Practical (Observation (5) and Record work (5))	10 marks
Attendance	05 marks
Total	**25 marks**

Note: Three assignments will be given and the marks will be converted to 10 marks.
  ➢ First assignment - Unit I & II
  ➢ Second assignment - Unit III & IV
  ➢ Third assignment - All Units
Each assignment should have five two marks questions and two five marks questions.

END SEMESTER EXAMINATION

Note:
1. The students should maintain theory assignment, observation note book / manual and record notebook. The assignment and record note book should be submitted during the Practical Examinations.
2. The question paper consists of theory and practical portions. All students should write the answers for theory portions (45 Marks) and practical portion (55 Marks).
3. For theory portions:
   Ten questions (2 from each unit) will be asked for 2 marks each. (10 x 2 = 20)
   Five questions (2 from each unit) will be asked for 5 marks each. (5 x 5 = 25)

6028M WORKSHOP PRACTICAL - II

I. PLUMBING
   Introduction of Plumbing Tools   04 Hrs

Exercises: **12 Hrs**

1. Cutting, bending and external threading of GI pipes using Die.
2. Install a sink and tap using different PVC pipe accessories such as bend, tee, socket and valve.
3. Install a washbasin and tap using different PVC pipe accessories such as bend, tee, socket and valve.
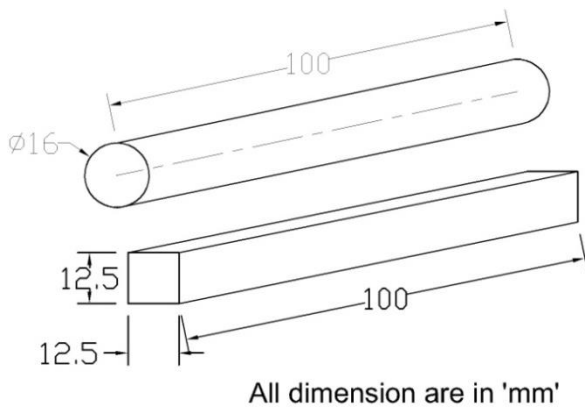4. To Repair and Replace all kinds of leaks.
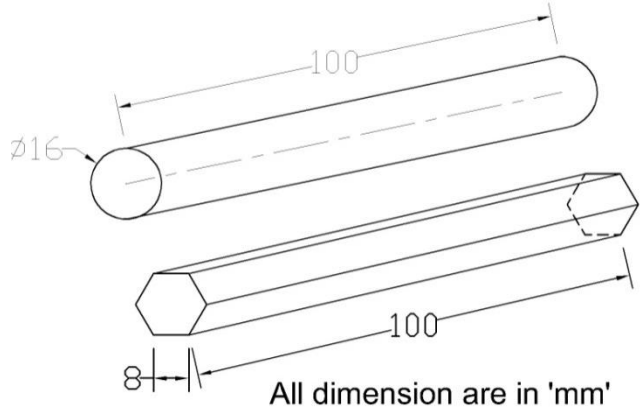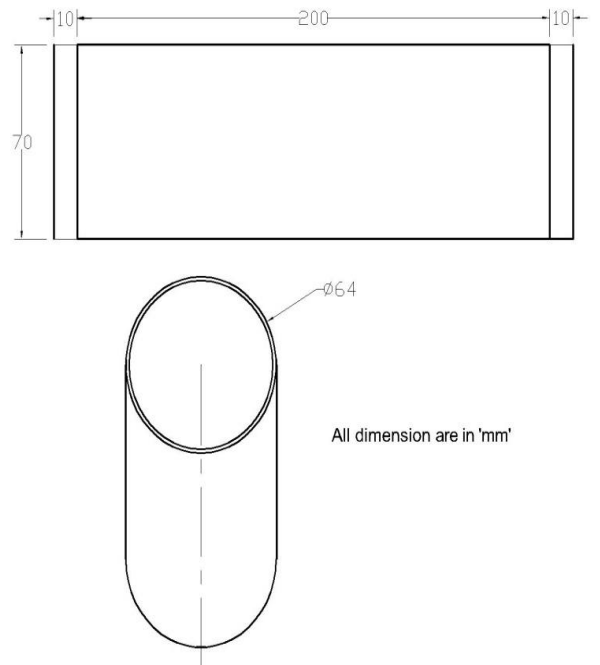
II. SMITHY
Introduction of Smithy tools and equipments   04 Hrs

Exercises: **12 Hrs**

1. Make a round rod to square rod from the given material Φ 16 mm x 100 mm.

2. Make a round rod to hexagonal rod from the given material Φ 16 mm x 100 mm .

3. Make a flat surface from the given material Φ 16 mm x 100 mm.
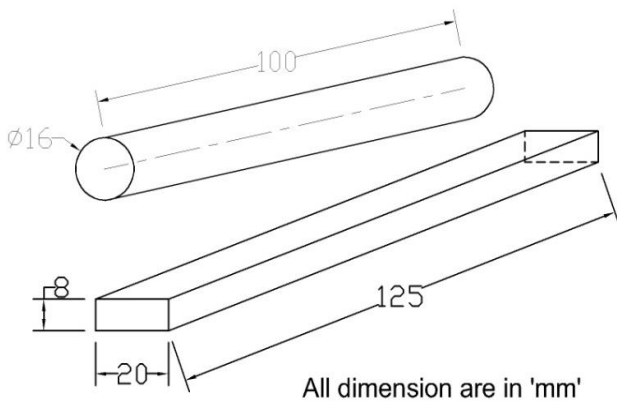
4. Make a 'S' bend from the given material 10 x 10 x 200 mm.
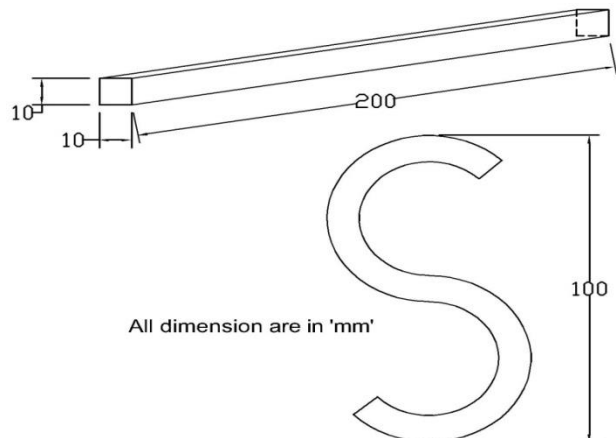
III.   SHEET METAL
Introduction of Sheet metal tools and equipments   04 Hrs
Exercises: **12 Hrs**

1. Make a square tray from the given sheet metal.

2. Make a cylindrical container from the given sheet metal .

All dimension are in 'mm'

All dimension are in 'mm'
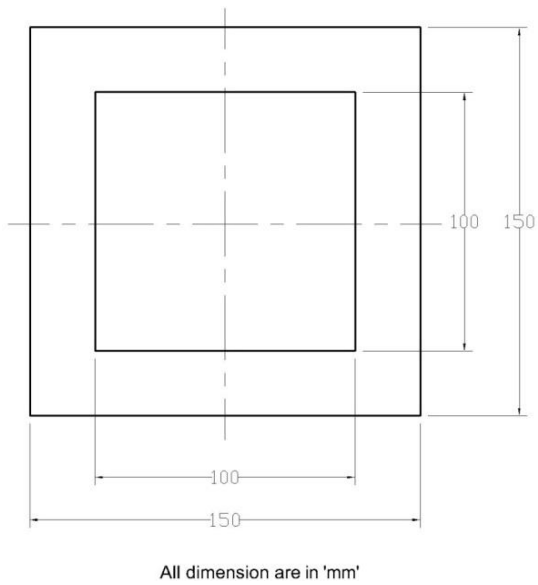
3. Make hopper from the given sheet metal.
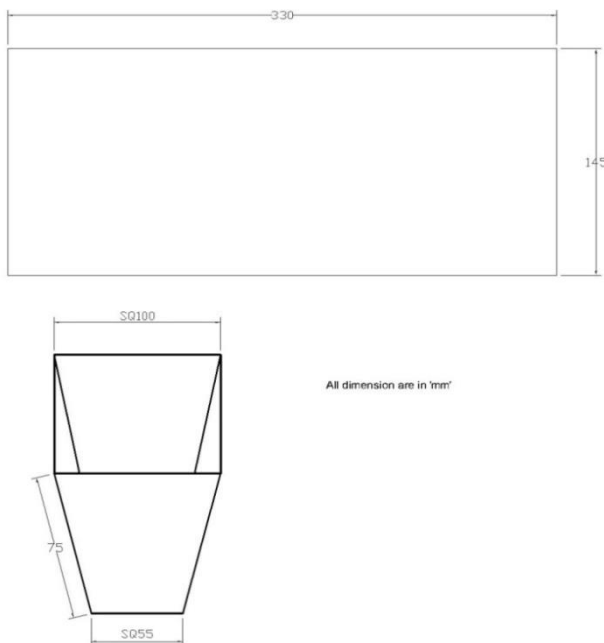
4. Make a dust bin from the given material

All dimension are in 'mm'

All dimension are in 'mm'
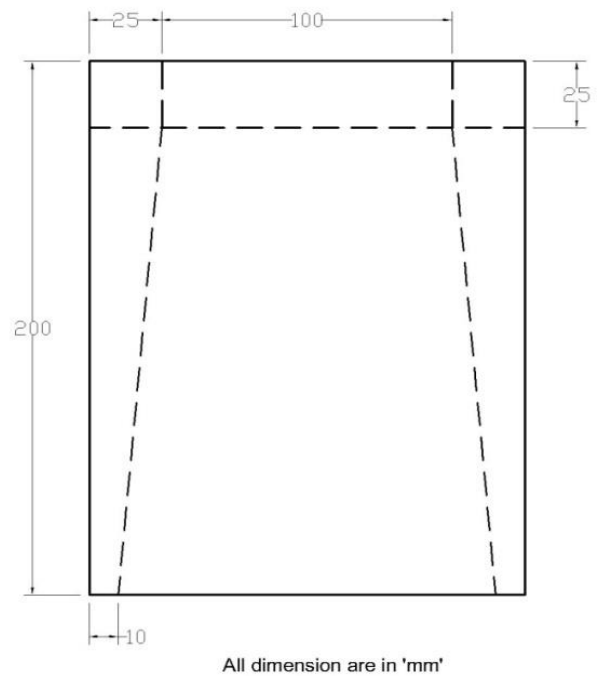
QUESTION PAPER PATTERN

A. Theory Question and Answer (5x9=45 Marks)	45 Marks
B. Plumbing Exercise	30 marks
C. Smithy or Sheet metal (Any one) Exercise	20 marks
Viva voce	05 marks
Total	**100 marks**

6002 COMPUTER APPLICATIONS PRACTICAL

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6002 COMPUTER APPLICATIONS PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	2 Hrs	32 Hrs	25	75	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Unit	Name of the Topics	Hrs
I	Basics of Computer: Computer basics - Hardware & software - General understanding of various computer hardware components - CPU - Memory - Display - Keyboard - Mouse - HDD & Other peripheral devices - Types of software - Application software & system software.	5
II	Word Processing: Creating new document - Opening an existing document - Edit & save a document - Typing a text - Deleting a text - Inserting a text - Finding a text - Replacing a text - Copying & moving a text - Selecting font & font size - Justifying texts - Bold - Italic - Underline - Strike - Double strike - Coloring text - Spell check - Ruler - Formatting page - Line spacing - Margins - Page size - Page border - Page color - Page columns - Watermark - Page break - Section break - Portrait - Landscape - Inserting symbols, equations & shapes - Text Box - Word art - Hyperlink - Inserting pictures - Picture arrangement - Align objects - Bullets & numbering - Working with tables - Header & footer - Table of contents - Inserting page number - Changing character width & line spacing - Printing the document - Print preview - Shortcuts for various activities in word - Exercises.	9
III	Spread sheet: Creating a new worksheet - Opening an existing worksheet - Editing and saving a worksheet - Creating, renaming and deleting worksheets in a workbook - Types of data like numeric, text etc. - Entering in a cell - Manipulation of a cell, row and column (deleting, inserting, finding, replacing, copying and moving) - Justifying in a cell, Merging cells and columns - Addition, subtraction and using formula - Selecting font and font sizes - Using and manipulating tables, inserting / deleting of rows and columns – Sorting columns-Using header and footer, Inserting page number - Border and shading of cells, rows and columns - Formatting page, margins, page size, portrait and landscape - Selecting area for printing - Printing of a worksheet and workbooks - Using print preview - Copy / moving text between two different worksheets and workbooks - Using chart wizard - Creation of different types of charts - Protect sheet using password - Shortcuts for various activities in spreadsheet - Exercises.	9
IV	Presentations: Creating new presentations - Opening presentations - Saving presentation - Inserting new slides - Slide layout - Slide design - Presentation view - Adding text - Font formatting - Paragraph formatting - Inserting clipart & pictures - Inserting and manipulating smart art - Running a slide show - Insert slide number - Slide header & footer - Applying slide animation - Custom animation - Inserting shapes - Insert Video & sound - Insert action - Hyperlinks - Charts - Tables - Page setup - Print preview - Printing - Shortcuts of various activities in presentations - Exercises.	9

Theory & Instruction Classes	08 Hours
Practical Experiments	20 Hours
Revision / Repetition	04 Hours
Total	**32 Hours**

EXERCISES

EXERCISE 1   (WORD PROCESSING)

Prepare a report from the given printed document of minimum 250 words. (Use text formatting tools, header & footer, page number, line spacing, font & images)

- **Page Setup:** Set Margin: Left - 1.5, Right - 1.5, Top - 1.5 & Bottom - 1.5 / Orientation: Portrait / Paper Size: A4 / No. of Columns: 2.
- Page Background Settings: Watermark / Page Color / Page Borders
- **Text & Paragraph Settings:** Title: Font size: 16 - Centered - Bold - Suitable font - Heading: Font size: 14 - Left aligned - Underlined - Set the suitable font face - Body text: Font size: 12 - Justified - 1.5 Line spacing - Set the suitable font face.
- **Header & Footer:** Header - Seminar name, Name of the student, Reg. No. & Branch Footer - Page No., Date and Time
- **Insert:** Picture / Clipart / Shapes / Table.
- **Minimum No. of words:** 250 words

EXERCISE 2   (WORD PROCESSING)

Create a resume for placement from the given printed template with your personal details. Publish a copy of the resume as PDF.

- **Page Setup:** Margin: Left - 0.5, Right - 0.5, Top - 0.5 & Bottom - 0.5 / Orientation: Portrait / Paper size: A4 / No. of columns: As per resume format.
- **Page Borders:** Insert page border if required.
- **Font & Paragraph:** Heading: Font size: 12 - Bold - Underlined - Set the suitable font - Face body text - Font size: 12 - Justified - 1 Line spacing - Set the suitable font - Insert bullets & numberings wherever required.
- **Insert:** Photo for your resume / tables.
- **Save as PDF:** Publish a copy of the resume as PDF using any PDF converting tools.

EXERCISE 3   (WORD PROCESSING)

Create a standard covering letter and use mail merge to generate the customized letters for applying to a job in various organizations. Also, create a database and generate labels for the applying organizations.

- **Page Setup:** Margin: Left - 1.5, Right - 1.5, Top - 1.5 & Bottom - 1.5 / Orientation: Portrait / Paper Size: A4
- **Page Background:** Add page border for the letter.
- **Font & Paragraph:** Title: Font size: 16 - Centered - Bold - Suitable font - Heading: Font size: 14 - Left Aligned - Underlined - Set the suitable font face , Body text: Font size: 12 - Justified - 1.5 Line spacing - Set the suitable font face.
- **Mailings:** Select recipients and add a new List of HR database. Start mail merge through step by step mail merge wizard

EXERCISE 4 (SPREAD SHEET)

Create a worksheet for the given relational data (minimum ten records) and show the data in the Line chart, Bar chart and Pie chart.

- **10 Records:** Add data to spreadsheet to the various fields require to analyze the data in chart.
- **Font & Alignment:** Font face - Font size - Font color.
- **Formulae:** Use formulae for the selected data for calculation.
- **Insert:** Charts - Line chart, Bar chart & Pie chart.

EXERCISE 5 (SPREAD SHEET)

Create a worksheet for the given data with various functions like sum, average, count, min, max & logical functions [IF, AND].

- **Data:** Create a worksheet and insert the various records to the cells.
- **Formatting:** Set the font using font name, font size and with various alignment tools.
- **Formulas and Functions:** Use some functions like sum, average, count, min, max and logical functions. [IF, AND]

EXERCISE 6 (SPREAD SHEET)

Create a worksheet for the given data and analysis the data with various filters and conditional formatting.

- **Data**
- **Formatting** Text: Font Face - Font Size - Font Color - Alignment
- **Functions**
- **Conditional Formatting**
- **Filters**

EXERCISE 7 (PRESENTATION)

Create a presentation of minimum 10 slides from engineering related topic.

- **Design & Layout:** Add a suitable Theme and Layout according to the content of all 10 slides.
- **Header & Footer:** Header: Insert the title & author; Footer: Insert the date & slide number
- **Font & Paragraph:** Font Face - Font Size - Font Color - Alignment - Bullets & Numberings
- **Insert:** Images & Tables

EXERCISE 8 (PRESENTATION)

Create a presentation of 10 slides about your college with Slide & Custom Animation, Shapes, Header & Footer, Slide number, Video, Audio, Picture, Tables and Hyperlink between slides.

- **Design & Layout:** Add a suitable Theme and Layout according to the content of all 10 slides.
- **Header & Footer:** Header: Insert the Title & Author; Footer : Insert the Date & Slide Number
- **Font & Paragraph:** Font Face - Font Size - Font Color - Alignment - Bullets & Numberings
- **Insert:** Video / Audio / Tables / Shapes
- **Hyperlink:** Use hyperlink to link between slides.
- **Animation:** Custom Animation for individual Objects / Slide Transition to all slides.

Note:
1. The student should be given proper training in all the exercises. All the exercises should be completed before examination.
2. The student should maintain observation note book / manual and record notebook. The record note book should be submitted during the Practical Examinations. Individual output for every exercise should be kept in the record note book.
3. During examination, the students are allowed to select any one exercise by lot. All exercises should be given for examination.

ALLOCATION OF MARKS

	Description	Marks
1	Aim & Procedure	20
2	Execution	50
3	Output printout / Handout	20
4	Viva voce	10
	Total	**100**

THIRD SEMESTER
6231 - STRENGTH OF MATERIALS

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6231 STRENGTH OF MATERIALS	6 Hrs	96 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
ENGINEERING MATERIALS, TESTING AND FRICTION

Chapter 1.1: Engineering Materials   **8 Hrs**

Classification - definition of mechanical properties - ferrous metals - cast iron - uses - advantages - types of cast iron - properties and applications - effect of impurities on cast iron. steel - classification - alloying elements - purpose of alloying - effect of alloying elements on steel - uses of steels - properties of mild steel - defects in steel - applications - properties of hard steel - market forms of steels - nonferrous metals - properties and uses.

Chapter 1.2: Mechanical Testing of Materials   **7 Hrs**

Compression test - bend test - hardness test - Brinell hardness test, Vickers hardness test, Rockwell hardness test - impact test - fatigue test - creep test - tensile test of mild steel in UTM - stress strain diagram - limit of proportionality - elastic limit - yield stress - breaking stress - ultimate stress - percentage of an elongation and percentage reduction in area - problems - torsion test - shear test.

Chapter 1.3: Friction   **3 Hrs**

Introduction - definition - force of friction - limiting friction - static friction - dynamic friction - angle of friction - coefficient of friction - laws of static and dynamic friction - description only.

UNIT - II
DEFORMATION OF METALS

Chapter 2.1: Simple Stresses and Strains   **5 Hrs**

Definition - load, stress and strain - classification of force systems: tensile, compressive and shear force systems. Hooke's law - definition - young's modulus - working stress, factor of safety, load factor, shear stress and shear strain - modulus of rigidity. Linear strain - deformation due to tension and compressive forces - simple problems in tension, compression and shear forces.

Chapter 2.2: Elastic Constants   **8 Hrs**

Definition - lateral strain - Poisson's ratio - volumetric strain - bulk modulus - volumetric strain of rectangular and circular bars - problems connecting linear, lateral and volumetric deformations - elastic constants and their relationship - problems on elastic constants. Composite bar - definition - problems in composite bars subjected to tension and compression. Temperature stresses and strains - simple problems.

Chapter 2.3 Strain Energy   **5 Hrs**

Definition - proof resilience - modulus of resilience - the expression for strain energy stored in a bar due to axial load - instantaneous stresses due to gradual, sudden, impact and shock loads - problems computing instantaneous stress and deformation in gradual, sudden, impact and shock loadings.

UNIT - III
GEOMETRICAL PROPERTIES OF SECTIONS AND THIN SHELLS

Chapter 3.1: Properties of sections   **10 Hrs**

Definition - center of gravity and centroid - position of centroid of plane geometrical figures such as rectangle, triangle, circle and trapezium - problems to determine the centroid of angle,

channel, T and I sections only - definition - centroidal axis - axis of symmetry. Moment of Inertia - parallel axis theorem and perpendicular axis theorem (statement only). Moment of Inertia of lamina of rectangle, circle, triangle, I and channel sections - definition - polar moment of Inertia - radius of gyration - problems computing moment of inertia and radius of gyration for angle, T, channel and I sections.

Chapter: 3.2: Thin Shells   8 Hrs

Definition - thin and thick cylindrical shell - failure of thin cylindrical shell subjected to internal pressure - derivation of hoop and longitudinal stress causes in a thin cylindrical shell subjected to internal pressure - simple problems - change in dimensions of a thin cylindrical shell subjected to internal pressure - problems - derivation of tensile stress induced in a thin spherical shell subjected to internal pressure - simple problems - change in diameter and volume of a thin spherical shell due to internal pressure - problems.

UNIT - IV
THEORY OF TORSION AND SPRINGS
Chapter 4.1: Theory of Torsion   9 Hrs

Assumptions - torsion equation $\dfrac{T}{J} = \dfrac{f_s}{R} = \dfrac{C\theta}{l}$ - strength of solid and hollow shafts - power transmitted - definition - polar modulus - torsional rigidity - strength and stiffness of shafts - comparison of hollow and solid shafts in weight and strength considerations - advantages of hollow shafts over solid shafts - problems.

Chapter: 4.2: Springs   8 Hrs

Types of springs and their applications - laminated and coiled springs and applications - difference between open and closely coiled helical springs - closely coiled helical spring subjected to an axial load - problems to determine shear stress, deflection, stiffness and resilience of closed coiled helical springs.

UNIT - V
SF AND BM DIAGRAMS OF BEAMS AND THEORY OF BENDING
Chapter 5.1: SF and BM diagrams   10 Hrs

Classification of beams - definition - shear force and bending moment - sign conventions for shear force and bending moment - types of loadings - Relationship between load, force and bending moment at a section - shear force diagram and bending moment diagram of cantilever and simply supported beam subjected to point load and uniformly distributed load (UDL) - determination of maximum bending moment in cantilever beam and simply supported beam when they are subjected to point load and uniformly distributed load - point of contraflexure (concept only).

Chapter: 5.2: Theory of bending   8 Hrs

Theory of simple bending - assumptions - neutral axis - bending stress distribution - moment of resistance - bending equation $\dfrac{M}{I} = \dfrac{f}{y} = \dfrac{E}{R}$ - definition - section modulus - rectangular and circular sections - strength of beam - simple problems involving flexural formula for cantilever and simply supported beam.

Reference Books:
1.   Strength of Materials, RS. Khurmi, S.Chand & Co., Ram Nagar, New Delhi.
2.   Strength of Materials, S. Ramamrutham, 15th Edition 2004, DhanpatRai Pub. Co., New Delhi.
3.   Strength of Materials, RK. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 3rd Edition, 2010.
4.   Strength of Materials, SS.Rattan, Tata Mcgraw hill, New Delhi,2008, ISBN 9780070668959,
5.   Strength of Materials, BK Sarkar, I Edition, 2003Tata Mcgraw Hill, New Delhi.
6.   Engineering Mechanics, RK. Bansal, Laxmi Publications Pvt. Ltd., New Delhi, 2nd Edition, 2007.
7.   Strength of Materials, Sadhu Singh, Khanna Publishers, New Delhi, 10th Edition, 2011.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6232 - MANUFACTURING TECHNOLOGY - I

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6232 MANUFACTURING TECHNOLOGY - I	Hrs / Week	Hrs / Sem	Marks			Duration
			Internal Assessment	External Exam*	Total	
	5 Hrs	80 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
CASTING PROCESSES

Chapter 1.1: Patterns   **3 Hrs**
Definition - pattern materials - factors for selecting pattern materials - types of pattern - solid piece, split patterns, loose piece, match plate, sweep, skeleton, segmental, shell - pattern allowances - core prints.

Chapter 1.2: Moulding   **6 Hrs**
Definition - moulding boxes, moulding sand - ingredients - silica - clay moisture and miscellaneous materials - properties of moulding sand - sand additives - moulding sand preparation - moulding tools - mixing - tempering and conditioning - types of moulding - green sand - dry sand - bench and floor moulding - machine moulding - top and bottom squeezer machines - jolting machines - sand slinger - core - CO_2 core making - types of core - core boxes.

Chapter 1.3: Casting   **6 Hrs**
Definition - sand casting using green sand and dry sand - gravity die casting - pressure die casting - hot and cold chamber processes - centrifugal casting - continuous casting - chilled casting - malleable casting - melting of cast iron - cupola furnace - melting of nonferrous metals - crucible furnace melting of steel - arc furnaces - induction furnaces - instrument for measuring temperature - optical pyrometer - thermo electric pyrometer - cleaning of casting - tumbling, trimming, sand and shot blasting - defects in casting - causes and remedies - safety practices in foundry.

UNIT - II
MODERN WELDING PROCESSES AND TESTING
Chapter: 2.1: Arc Welding   **5 Hrs**
Definition - arc welding equipment - arc welding methods - carbon arc, metal arc, Metal Inert Gas (MIG), Tungsten Inert Gas (TIG), atomic hydrogen, plasma arc, submerged arc and electro slag welding.

Chapter: 2.2: Gas, Modern Welding Processes and Testing   **10 Hrs**
Definition - gas welding equipment - oxy and acetylene welding - three types of flame - resistance welding - classification of resistance welding - butt - spot - seam - projection welding - welding related processes - oxy and acetylene cutting - arc cutting - hard facing bronze welding - soldering and brazing. Special welding processes - cast iron welding - thermit welding - solid slate welding, ultrasonic, diffusion and explosive welding - explosive cladding - modern welding, electron beam and laser beam welding - types of welded joints - merits and demerits of welded joints - inspection and testing of welded joints - destructive and nondestructive types of tests - magnetic particle test - radiographic and ultrasonic test defects in welding - causes and remedies - safety practices in welding.

UNIT - III
BULK DEFORMATION PROCESSES AND HEAT TREATMENT
Chapter: 3.1: Forming   **7 Hrs**
Hot working, cold working - advantages of hot working and cold working- hot working operations - rolling, forging, smith forging, drop forging, upset forging, press forging - roll forging - Press working: types of presses - mechanical and hydraulic presses - types of drives - press tool and accessories - press working operations - bending operations - angle bending - curling - drawing - shearing operations - blanking, piercing, trimming, notching and lancing.

Chapter: 3.2: Heat treatment   **8 Hrs**

Heat treatment processes - purpose - procedures - applications of various heat treatment processes - Iron-carbon equilibrium diagram - full annealing - process annealing stress relief annealing - spherodising annealing - isothermal annealing - normalizing - hardening - tempering - quenching medium - different types and their relative merits - case hardening - pack carburizing - cyaniding - nitriding - induction hardening and flame hardening.

UNIT - IV
MANUFACTURING OF PLASTIC COMPONENTS AND POWDER METALLURGY
Chapter: 4.1: Plastic Components   3 Hrs
Types of plastics - engineering plastics - thermosets - composite - structural foam - elastomers - polymer alloys and liquid crystal polymers.
Chapter: 4.2: Processing of Plastics   6 Hrs
Extrusion - general features of single screw extrusion - twin screw extruders - reciprocating screw injection - details of injection mould - structural foam injection mould - sandwich moulding - gas injection moulding - injection moulding of thermosetting materials - calendaring and rotational moulding - design consideration for plastic components.
Chapter: 4.3: Powder Metallurgy   6 Hrs
Methods of manufacturing metal powders - atomization, reduction and electrolysis deposition - compacting - sintering - sizing - infiltration - mechanical properties of parts made by powder metallurgy - design rules for the powder metallurgy process.

UNIT - V
CENTRE LATHE AND SPECIAL PURPOSE LATHES
Chapter: 5.1: Centre Lathe   5 Hrs
Centre lathe: specifications - simple sketch with principal parts. Head stock: back geared type - all geared type - description only - working principles of tumbler gear mechanism, quick change gear box, apron mechanism, carriage cross slide. Feed mechanism: automatic feed, longitudinal feed and cross feed - construction and working of tail stock. Work holding device: face plate - three jaw chuck - four jaw chuck - catch plate and carrier - center. Operations: straight turning - step turning - taper turning - knurling - thread cutting - facing - boring - eccentric turning - grooving - parting off - chamfering - cutting speed - feed - depth of cut.
Chapter: 5.2: Semi-Automatic Lathes   4 Hrs
Types of semi-automatic lathes - capstan and turret lathes - difference between turret and capstan - Geneva indexing mechanism - bar feeding mechanism.
Chapter: 5.3: Automatic Lathes   4 Hrs
Automatic lathe - construction and working principle of single spindle automatic lathe - automatic screw cutting machines - multi spindle automatic lathes.

Reference Books:
1. Elements of workshop technology Volume I & II - Hajra Chowdry & Bhattacharaya, IIth Edition, Media Promoters & Pub. Pvt. Ltd., Mumbai 400 007 - 2007.
2. Manufacturing process - Begeman - 5th Edition,Tata McGraw Hill, New Delhi, 1981.
3. Workshop technology, WAJ Chapman, Vol I, II, & III, Vima Books Pvt.Ltd., New Delhi 110 002.
4. Workshop Technology, Raghuwanshi, Jain & Gupta, Khanna Publishers.
5. Production Technology, PC. Sharma - Ed. X - S. Chand & Co. Ltd., New Delhi 110 055 - 2006
6. Manufacturing Technology, Thomas Neil Raj, 2nd Ed., Anuradha Agencies, Kumbakonam, 2014.
* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6233 - MEASUREMENTS AND METROLOGY
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6233 MEASUREMENTS AND METROLOGY	Hrs / Week	Hrs / Sem	Marks			Duration
			Internal Assessment	External Exam*	Total	
	5 Hrs	80 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
BASIC CONCEPTS OF MEASUREMENTS
Chapter 1.1: Introduction 7 Hrs
Basic units - system concepts used in measuring technology - measuring instruments - length, angles and surface - scope of metrology - standardization - international standardization, the Bureau of Indian Standards (BIS) - legal metrology - definition - applications - important elements of measurements - methods of measurements - needs for inspection - need for measurement - important terminology.

Chapter 1.2: Precision and Accuracy 8 Hrs
Precision - definition - accuracy - definition - difference between precision and accuracy - factors affecting the accuracy of the measuring system - general rules for accurate measurements - precautions for use of instruments so as to avoid in accuracy in measurements - reliability - definition - error - definition - sources of errors - classification of error - compare systematic error and random error - selection of measuring instruments - symbols for metallurgical terms (ASME and ISO).

UNIT - II
LINEAR AND ANGULAR MEASUREMENTS
Chapter 2.1: Linear measurements 7 Hrs
Classification of linear measurement instrument - construction and the principles only - steel rule - calipers - outside caliper, inside caliper, jenny caliper - combination set - feeler gauge - pitch screw gauge - vernier caliper - digital caliper - vernier height gauge- micrometer - inside micrometer - thread micrometer - optical micrometer - light wave micrometer - possible sources of errors in micrometers - slip gauges - requirements - Indian standard - care and use.

Chapter 2.2: Angular measurements 8 Hrs
Introduction - vernier bevel protractor - universal bevel protractor - optical bevel protractor. Sine bar - types - uses and limitations - working principle of clinometer, autocollimator, angle dekkor. Comparators - uses - application - classification - mechanical comparator, optical comparator, electrical comparator, pneumatic comparator - principles - advantages and disadvantages - compare comparator with measuring instruments - compare electrical and mechanical comparators.

UNIT - III
FORM MEASUREMENTS
Chapter 3.1: Measurement of screw threads 5 Hrs
Screw thread terminology - error in thread - measurement of various elements of thread (description only) - thread gauges - classification plug screw gauges, ring screw gauges, caliper gauges - adjustable thread gauge - gauging of taps - function of various types of gauges floating carriage micrometer.

Chapter 3.2: Measurement of gears 10 Hrs
Introduction - types of gear - gear terminology - gear errors - spur gear measurement - run out, tooth measurement, profile measurement, lead checking , backlash checking, tooth thickness measurement - vernier gear tooth caliper - Davidbrown tangent comparator - constant chord method - measurement of concentricity - alignment checking - Parkinson gear tester - rolling gear testing machine - radius measurement - radius of circle - surface finish measurement - classification of geometrical irregularities - elements of surface texture - methods of measuring surface finish - measuring surface roughness - tracer type profilogram - double microscope.

UNIT - IV
ADVANCES IN METROLOGY
Chapter 4.1: Laser Metrology 7 Hrs
Basic concepts of lasers - types of lasers - uses, advantages and applications - laser telemetric system - laser and LED based distance measuring instruments - scanning laser gauge - photodiode array imaging - diffraction pattern technique - laser triangulation sensors - two frequency laser interferometer - gauging wire diameter from the diffraction pattern formed in laser

- interferometry - use of laser in interferometry - interferometer - standard interferometer, single beam interferometer, AC interferometer, Michelson interferometer, dual frequency laser interferometer - Twyman green interferometer - applications.

Chapter: 4.2: Computer in Metrology   **7 Hrs**

Coordinating measuring machine - introduction - types of measuring machines - types of CMM - futures of CMM - causes of errors in CMM - Three co-ordinate measuring machine - performance of CMM - applications - advantages disadvantages - computer controlled coordinating measuring machine - mechanical system of computer controlled CMMs - trigger type probe system - measuring type prop system - features of CNC and CMM - features of CMM software - factors affecting CMM - digital devices - computer based inspection - computer aided inspection using robots.

UNIT - V
MEASUREMENT OF MECHANICAL PARAMETERS

Chapter 5.1: Force and Torque   **5 Hrs**

Measurement of force - direct methods - equal arm balance, unequal arm balance, multiple lever system, pendulum scale - indirect methods - electromagnetic balance - load cells - hydraulic load cell - pneumatic load cell - strain gauge load cell - shear type load cell - electronic weighing system. Torque measurement - torque measurement using strain gauge - laser optical torque measurement - stroboscope for torque measurement.

Chapter 5.2: Measurement of power   **3 Hrs**

Mechanical dynamometer - DC dynamometer - inductor dynamometer - hydraulic dynamometer - diaphragm pressure sensor - deform cage with LVDT - diaphragm gauge with strain gauges - piezoelectric sensors.

Chapter 5.3: Measurement of flow   **3 Hrs**

Types of flow meters - Rotameter, Electromagnetic flow meter, Hot wire anemometer, Ultrasonic flow meter, Laser Doppler Anemometer (LDA) - reference beam mode - interference french mode.

Chapter 5.4: Measurement of temperature   **3 Hrs**

Introduction - definition of temperature - types of thermometer - bi-metallic, pressure, resistance thermometers - thermistor - types - advantages and limitations - thermocouple.

Reference Books:

1. Mechanical Measurements and Instrumentation, R K. Rajput, SK.Kataria
2. Mechanical Measurement and Control, Jalgaonkar RV, Everest Publishing House.
3. Mechanical and Industrial Measurements, RK Jain, Khanna Publications.
4. Instrumentation Devices and Systems, CS Narang, Tata McGraw Hill Publications.
5. Instrumentation, Measurement and Analysis, Nakra BC, Chaudhary K.K, Tata McGraw Hill Pub.
6. Engineering Metrology and Measurements, S. Baskar, Anuradha Publications.
7. Metrology and Measurements, Anand K Becvoor, Vinay A Kulkarni, Tata McGraw Hill

   * Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6234 - ELECTRICAL DRIVES AND CONTROL
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6234 ELECTRICAL DRIVES AND CONTROL	6 Hrs	96 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
DC CIRCUITS AND DC MACHINES
Chapter 1.1: DC Circuits   **9 Hrs**
Definition - electric current - voltage and resistance - Ohm's law and Kirchoff's law - resistance in series, parallel and series parallel - simple problems - electromagnetism (definition only) - magnetic flux - flux density - magnetic field intensity - MMF - permeability - reluctance - Faraday's law of electromagnetic induction - electrical and mechanical units.

Chapter 1.2: DC Machines   **9 Hrs**
DC Generators - construction, principle of operation and applications - DC motors - construction, principle of operation and applications - necessity of starters - three point, four point starters.

UNIT - II
AC CIRCUITS AND AC MACHINES
Chapter 2.1: AC Circuits   **9 Hrs**
Fundamentals of AC voltage and current - peak, average, RMS value of sine wave, frequency, time period, amplitude, power and power factor (definition only). Transformer: principle of operation and construction - EMF equation - losses in transformer - efficiency - applications - alternator construction - principle of operation and applications.

Chapter 2.2: AC Machines   **9 Hrs**
AC machine: AC motors - principle of operation of single phase, capacitor start induction motor - universal motor - applications - three phase induction motors - squirrel cage and slip ring induction motors (construction and working principle only) - applications - speed control of 3Φ induction motor - DOL and star / delta starter.

UNIT - III
SPECIAL MACHINES & DRIVES
Chapter 3.1: Special Machines   **9 Hrs**
PMDC motor - stepper motor - construction and working principle and applications - servo motor - types - permanent magnet servo motor - construction and applications - brushless servo motor - construction and applications.

Chapter: 3.2: Industrial Drives   **9 Hrs**
Industrial drives - types, group drive, individual drive, multi motor drive - block diagram of Variable Frequency Drive (VFD) - stepper motor drive - single stepping and half stepping servo drives - DC servo drive - AC servo drive and BLDC servo drive.

UNIT - IV
POWER SUPPLIES, CONTROL ELEMENTS AND ELECTRICAL SAFETY
Chapter 4.1: Power Supplies   **7 Hrs**
Diode - forward biasing and reverse biasing - rectifiers - half wave, full wave and bridge rectifiers - necessity of filters - regulated power supplies - IC voltage regulators - batteries - working principle, construction, maintenance and troubleshooting - UPS - online UPS and offline UPS.

Chapter 4.2: Control Elements   **7 Hrs**
Fuses - selection of fuse - necessity of fuse - fuse switch units. Sensors: photoelectric sensor, inductive proximity sensors, temperature sensors. Contactors - usage - necessity of contactor -

solenoid type contactor. Circuit breakers - Miniature Circuit Breaker (MCB) - Earth Leakage Circuit Breaker (ELCB)

Chapter 4.3: Electrical Safety   4 Hrs

Electrical safety - importance of earthing - electric shock - first aid - precautions - causes of accident and their preventive measures.

UNIT - V

DISPLAY DEVICES, LOGIC GATES AND PLC

Chapter 5.1: Display Devices   5 Hrs

Display devices - LCD - LCD applications - LED - 7 segment LED - LED applications.

Chapter 5.2: Logic Gates   6 Hrs

Logic gates - positive and negative logic - definition - symbol and truth table - Boolean expression for OR, AND, NOT, NOR, NAND, EXOR and EXNOR gates - universal logic gates - NAND and NOR.

Chapter 5.3: PLC   6 Hrs

Features of PLC - PLC block diagram - PLC scan - fixed and modular PLC - ladder logic - NO, NC contacts - coils - AND logic - OR logic - XOR logic - NOT logic.

Reference Books:

1. Fundamentals of Physics, BL Theraja.
2. Fundamentals of Electricity, DN. Vasudeva, S. Chand & Co.
3. Electric Motors and Generators, Odhams
4. A text book of Electrical Technology, Volume II, BL Theraja, S Chand & Co.
5. Programmable Logic Controllers, John R Hackworth & Frederick D.Hackworth Jr., Pearson

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6235 - MACHINE DRAWING AND CAD PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6235 MACHINE DRAWING AND CAD PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	5 Hrs	80 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

PART - A: MANUAL DRAWING PRACTICE

Chapter 1.1: Sectional Views   4 Hrs

Sectioning - sectional views - representation of sectional plane - hatching - inclination - spacing - hatching large areas - hatching adjacent parts - full section - half section - types of half sections - conventional representation of materials in section - dimensioning.

Chapter 1.2: Limits, Fits and Tolerances   3 Hrs

Tolerances - allowances - unilateral and bilateral tolerances - limits - methods of tolerances - indication of tolerances on linear dimension of drawings - geometrical tolerances - applications - fits - classification of fits - selection of fits - examples.

Chapter 1.3: Surface Texture   3 Hrs

Surface texture - importance - controlled and uncontrolled surfaces - roughness - waviness - lay - sampling length - machining symbols.

Chapter 1.4: Assembly Drawing   42 Hrs

Detailed drawings of the machine parts are given to students to assemble and draw any two views of the machine elements in the drawing sheet with dimensions front view / sectional front view (full section / half section) and top view / left side view / right side view.

PART - B: COMPUTER AIDED DRAFTING (CAD)   28 Hrs

CAD applications - hardware requirement - software requirement - CAD screen interface - menus - toolbars - types of co-ordinate system - creating 2D objects - using draw commands - creating text - drawing with precision - Osnap options - drafting settings - drawing aids - fill, snap, grid, ortho lines - function keys - editing and modify commands.

Object selection methods - erasing object - oops - cancelling and undoing a command - copy - move - array - offset - scale -rotate - mirror - break - trim - extend - explode. divide - measure - stretch - lengthen - changing properties - color - line types - ltscale. matching properties - editing with grips - Pedit - Ddedit - Mledit - basic dimensioning - editing dimensions - dimension styles - dimension system variables. machine drawing with CAD. creation of blocks - wblock - inserting a block - block attributes - hatching - pattern types - boundary hatch - working with layers - controlling the drawing display - Blipmode.

View group commands - zoom, redraw, regen, regenauto, pan, viewers - real time zoom. inquiry groups - calculating area - distance - time - status of drawing - using calculator. plot detailed drawings of the machine parts are given to students to assemble and create two views of the machine elements in the CAD package with dimensions. front view / sectional front view (full section / half section) and top view / left side view / right side view.

EXERCISES:
Draw the front view / sectional front view (full section / half section) and top view / left side view / right side view for the following given part drawing of the components using CAD package after drawing assembled views in the drawing sheet manually.

1. Sleeve & Cotter Joint

2. Screw Jack

3. Plummer Block

4. Simple Eccentric

5. Machine Vice

6. Universal Coupling

7. Protected Type Flanged Coupling

Reference Books:
1. A Textbook of Machine Drawing, Pritam Singh Gill, SK. Kataria & Sons.
2. Introducing Autocad 2010 and Autocad LT 2010, George Omura, Wiley IndiaPvt. Ltd.
3. A Textbook of Engineering Drawing, RB.Gupta, Satyaprakasan, Technical India Publications.
4. Engineering Drawing, DN. Ghose, Dhanpat Rai & Sons, New Delhi
5. Machine Drawing, KL Narayana and P Kannaiah, Newage Int. Pub. 5th Edition, 2016.
6. Machine Drawing, KR Gopalakrishna, Subhas Publishing, 2012

Note:
All the students should maintain the observation cum record note book / manual as per the regulations. The printout of the actual CAD output created by the student during practice should be pasted for every exercise in the observation cum record note work.

For every exercise, manual drawing sheet (two views) should be submitted and evaluated for 50 marks. (front view - 30 marks and top view / side view - 20 marks). The average of the seven exercises should be converted to 10 marks.

Drawing sheet (seven exercises average)	- 10 Marks
Observation and record work	- 10 Marks
Attendance	- 05 Marks
Total	**- 25 Marks**

AUTONOMOUS EXAMINATION

Note: All the exercises should be completed by manual and CAD. All the exercise should be given for examination, the students are permitted to select by lot. Observation cum record note book should be submitted during examination along with the drawing file.

PART A: Manual Drawing in the Drawing sheet
Draw the assemble front view / sectional front view (full section / half section) and top view / left side view / right side view for the given part drawing of the components in the drawing sheet.

PART B: Computer Aided Drafting in the CAD package
Create the assemble front view / sectional front view (full section / half section) and top view / left side view / right side view for the given part drawing of the components in any one of the CAD package.

DETAILLED ALLOCATION OF MARKS

Manual Drawing in Drawing Sheet	:	**30 marks**
Computer Aided Drafting	:	**60 marks**
(Drafting: 20 Marks, Assembly: 20 Marks & Dimensioning: 20 Marks)		
Viva-voce	:	**10 marks**
Total	:	**100 marks**

6236 - MANUFACTURING TECHNOLOGY - I PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6236 MANUFACTURING TECHNOLOGY - I PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

Lathe: Study of lathe parts and its functions - operations - plain turning, step turning, taper turning, knurling, thread cutting, bushing, eccentric turning, boring.

Foundry: Study of foundry - green sand - properties - patterns - types - solid pattern - stepped pulley, bearing top, gear wheel. split pattern - yoke - bent pipes, dumbbells - loose piece pattern - dovetail - core - cores sand - cylindrical core making.

Welding: Arc welding principles and components - arc welding - lap joint - butt joint, T joint, corner joint. Gas welding equipments - components - gas welding - lap joint, butt joint, T joint, corner joint. gas cutting - spot welding - flash butt welding.

EXERCISES
PART A - LATHE EXERCISES

30 Hrs

Note: All dimensions are in mm. All linear dimensions are in ± 0.5 mm tolerance. All cylindrical dimensions are in ± 0.2 mm tolerance. Estimate the cost of the job for following exercises for MS round rod with suitable raw material for the final size. Final job of the raw material should be retained for verification.
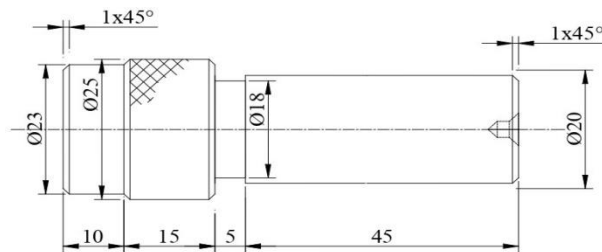
1. Prepare the specimen and make the step turning & taper turning as shown in figure using lathe.
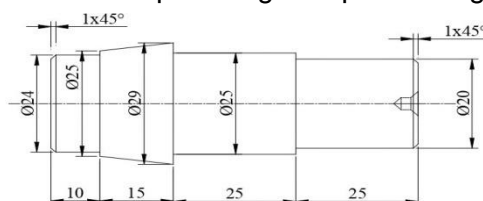
2. Prepare the specimen and make step turning & BSW thread cutting as shown in figure using lathe.
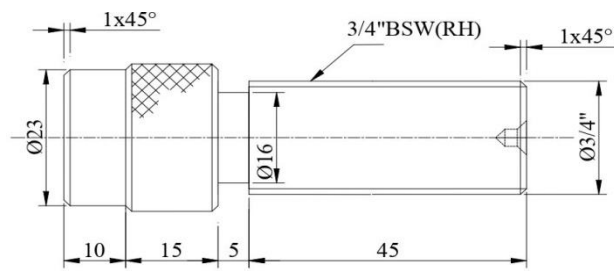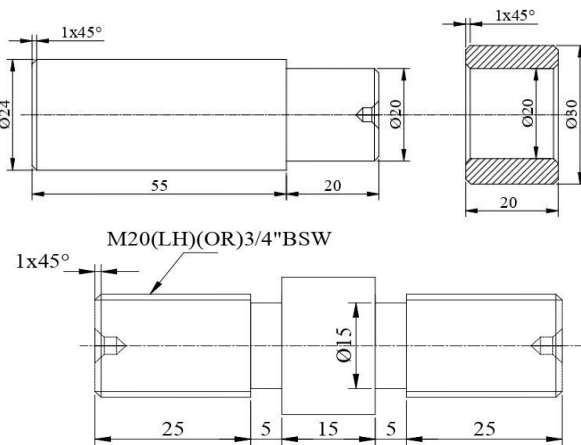

3. Prepare the specimen and make the step turning & knurling as shown in figure using the lathe.

4. Prepare the specimen and make the shaft and bush as shown in figure using step turning and boring operation in Lathe.

5. Prepare the turning & BSW shown in specimen and make the step and metric thread cutting as figure using lathe.

6. Prepare the specimen and make the eccentric turning as shown in figure using lathe.
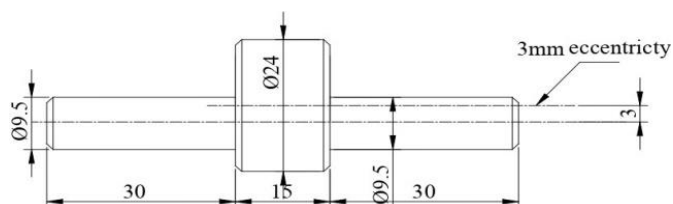
PART B – FOUNDRY AND WELDING EXERCISES   **34 Hrs**

1. Prepare the green sand moulding using any one solid pattern in foundry.
2. Prepare the green sand moulding using any one split pattern in foundry.
3. Prepare the green sand moulding using any one loose piece pattern in foundry.

4. Prepare the specimen and make the lap joint by arc welding. (Both side welded). (Raw material 25 mm x 6 mm MS flat).
5. Prepare the specimen and make the corner joint by gas welding. (Raw material 25 mm x 3 mm MS sheet).
6. Prepare the specimen and make the joint by spot welding.
7. Prepare the specimen and make the joint by flash butt welding.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Procedure / Preparation	10
2	Machining / Dimensions	30
3	Finishing	10
Part - B		
4	Procedure / Edge Preparation	10
5	Ramming / Penetration	25
6	Finishing / Gate Cutting	05
7	Viva-voce	10
Total		**100**

6237 - ELECTRICAL DRIVES AND CONTROL PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6237 ELECTRICAL DRIVES AND CONTROL PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXPERIMENTS:
PART - A   ELECTRICAL LABORATORY 32 Hrs
1. Verification of Ohm's Law.
2. Load test on DC shunt motor.
3. Load test on single phase induction motor.
4. Load test on three phase squirrel cage motor.
5. Testing of relays, contactors, push buttons and limit switch.
6. Testing of 3 point, 4 point starters
7. Testing of AC starters.
PART - B   ELECTRONICS LABORATORY 32 Hrs
1. Construction and testing of half wave and full wave rectifier.

2. Construction and testing of IC voltage regulator using IC 7805.
3. Verification of truth tables for logic gates.
4. Verification of universal gates.
5. Identification and testing of display devices - LED, 7 segment LED, laser diode.
6. Testing of stepper motor drive.
7. Testing of servo motor drive.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Circuit Diagram	10
2	Connections & Readings	20
3	Calculations & Graph	15
Part - B		
4	Circuit Diagram	10
5	Connections & Readings	20
6	Execution	15
7	Viva-voce	10
Total		**100**

FOURTH SEMESTER

6241 - FLUID MECHANICS AND FLUID POWER

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6241 FLUID MECHANICS AND FLUID POWER	6 Hrs	96 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
PROPERTIES OF FLUIDS & FLUID PRESSURE
Chapter 1.1: Properties of Fluids   **6 Hrs**
Fluid - definition - classification - ideal and real fluids - properties - density, specific gravity, specific weight, specific volume, dynamic viscosity, kinematic viscosity, surface tension, capillarity, vapour pressure and compressibility - problems.
Chapter 1.2: Fluid Pressure and Its Measurement   **12 Hrs**
Fluid pressure - units of pressure - hydrostatic law - pressure head - Pascal's Law - proof - applications - hydraulic press - hydraulic jack - concepts of absolute, vacuum, gauge and atmospheric pressures. Pressure measurements - simple U tube manometers and differential manometers and their types - problems - Bourdon tube pressure gauge - diaphragm and dead

weight pressure gauge - pressure sensor technologies (classification only). Total pressure - centre of pressure on immersed bodies (flat, vertical) - problems.

UNIT - II
FLUID FLOW, FLOW THROUGH PIPES & IMPACT OF JET
Chapter 2.1: Fluid Flow   7 Hrs
Types of fluid flow - laminar, turbulent, steady, unsteady, uniform, non-uniform, rotational, irrotational - discharge of a flowing fluid - continuity equation - energies of a fluid - Bernoulli's theorem - assumptions - derivation - applications and limitations - problems. Venturimeter - construction - working principle, coefficient of discharge - derivation for discharge. Orificemeter - construction - working principle, coefficient of discharge - derivation for discharge - problems - difference between venturimeter and orificemeter - orifice and mouthpiece (definition only) - hydraulic coefficients - experimental determination of C_c, C_v and C_d - pitot tube - construction and working principle only.

Chapter 2.2: Flow through Pipes   6 Hrs
Laws of fluid friction for laminar and turbulent flow - Darcy's equation and Chezy's equation for frictional losses - problems. Minor losses - description. Hydraulic gradient line and total energy line - hydraulic power transmission through pipes - problems.

Chapter: 2.3: Impact of Jet   5 Hrs
Impact of jet on fixed vertical plate - Impact of jet on moving vertical flat plates in the direction of jet - impact of jet on a series of moving plates or vanes - problems on work done and efficiency.

UNIT - III
HYDRAULIC TURBINES, CENTRIFUGAL PUMPS & RECIPROCATING PUMPS
Chapter 3.1: Hydraulic Turbines   6 Hrs
Layout of a hydro electric power plant - classification of hydraulic turbines and their applications - construction and working principle of Pelton wheel, Francis and Kaplan turbine. Draft tubes - types and construction - concept of cavitation in turbines - surge tank and its need - difference between impulse turbine and reaction turbine.

Chapter: 3.2: Centrifugal Pumps   6 Hrs
Construction - principle of working - types of casings and impellers - concepts of multi-stage - priming and its methods - manometric head, work done, manometric, mechanical and overall efficiencies - problems - special pumps - jet pump - turbine pump - submersible pumps.

Chapter: 3.3: Reciprocating Pumps   6 Hrs
Construction, working principle and applications of single and double acting reciprocating pumps - discharge - theoretical power required - coefficient of discharge - problems - concepts of slip - negative slip - cavitation and separation - use of air vessel - indicator diagram with effect of acceleration head and friction head.

UNIT - IV
HYDRAULIC SYSTEMS
Chapter 4.1: Introduction to Fluid Power Systems   5 Hrs
Fluid power systems - general layout - components of hydraulic and pneumatic systems - practical applications of fluid power systems - comparison - advantages and limitations.

Chapter: 4.2: Components of Hydraulic Systems   8 Hrs
Hydraulic fluid - service properties of hydraulic fluid - ISO symbols of basic hydraulic components - types, construction, working principle and symbol of the following components - Pump: vane, gear and piston pumps. Valves: pressure control valves - pressure relief valve, pressure reducing valve, pressure unloading valve. Direction control valve: poppet valve - spool valve - 3/2, 4/2 & 4/3 DC valves - sequencing valve - flow control valve - pressure compensated - non-pressure compensated. Actuators - linear actuators - single acting and double acting - rotary actuators - hydraulic motors - accessories - intensifiers and accumulators.

Chapter 4.3: Hydraulic Circuits   5 Hrs
Double acting cylinder with metering in, metering out circuits - pump unloading cut - bleed-off circuit - sequencing circuit - hydraulic circuits for milling machine, shaping machine and motion synchronisation circuit.

UNIT - V

PNEUMATIC SYSTEMS

Chapter: 5.1: Components of Pneumatic Systems 9 Hrs

Basic components - FRL unit - ISO symbols of basic pneumatic components - types, construction, working principle and symbol of the following components: Compressor - reciprocating and rotary compressors. Valves: pressure control valves - pressure relief valves - pressure regulating valves. Direction control valves - 3/2, 4/3, 5/2 & 5/3 DC valves - sequencing valve - flow control valve - throttle valves - shuttle valves - quick exhaust valves. Actuators - linear actuators - single acting & double acting - rotary actuators - air motors - accessories.

Chapter: 5.2: Pneumatic Circuits 8 Hrs

Double acting cylinder with metering in, metering out circuits - speed control circuit and sequencing circuit - use of shuttle valve in pneumatic circuit - use of quick exhaust valve in pneumatic circuit.

Reference Books:

1. A Textbook of Fluid Mechanics and Hydraulic Machines, RK Bansal, Laxmi Pub. (P),Ltd, 2010
2. Hydraulics and Fluid Mechanics, Modi PN. and Seth, SM. Standard BookHouse, New Delhi, 2013.
3. Fluid Power with Applications, Anthony Esposito, Pearson Education, 2005.
4. A Textbook of Fluid Mechanics, RK Rajput, S.Chand & Co, New Delhi, 2019
5. Engineering Fluid Mechanics, KL Kumar, Eurasia Publishing House (P) Ltd.,New Delhi, 2016.
6. Oil Hydraulics Systems- Principles and Maintenance", SR Majumdar., Tata McGraw- Hill, 2001.
7. Hydraulic and Pneumatic Controls, K Shanmugasundaram, Chand & Co,2006

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6242 - MANUFACTURING TECHNOLOGY - II

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6242 MANUFACTURING TECHNOLOGY - II	6 Hrs	96 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
THEORY OF METAL CUTTING, DRILLING MACHINE & ABRASIVE PROCESS

Chapter 1.1: Theory of Metal Cutting 6 Hrs

Introduction - orthogonal cutting - oblique cutting - single point cutting tool - nomenclature - types of chips - chip breakers - cutting tool materials - properties - tool wears - factors affecting tool life - cutting fluids - functions - properties of cutting fluid.

Chapter 1.2: Drilling Machines 5 Hrs

Drills - flat drills - twist drills - nomenclature of twist drill - types of drilling machines - bench type - floor type - radial type - gang drill - multi spindle type - principle of operation in drilling - methods of holding drill bit - drill chucks - socket and sleeve - drilling operation - reaming, counter sinking, counter boring, spot facing, tapping and deep hole drilling.

Chapter 1.3: Abrasive Processes 7 Hrs

Types and classification - specifications - rough grinding - pedestal grinders - portable grinders - belt grinders. Precision grinding - cylindrical grinder - centerless grinders - surface grinder - tool and cutter grinder - planetary grinders - principles of operations - grinding wheels - abrasives - natural and artificial diamond wheels - types of bonds - grit, grade and structure of wheels - wheel shapes and sizes - standard marking systems of grinding wheels - selection of grinding wheel - mounting of grinding wheels - dressing and truing of wheels - glazing and loading of grinding wheels - balancing of grinding wheels.

UNIT - II

RECIPROCATING MACHINES

Chapter 2.1: Planer   **5 Hrs**

Introduction - description of double housing planner - open side planner - pit planner - edge planner - divided table type planner - specifications - principles of operation - drives - quick return mechanism - feed mechanism - operations.

Chapter 2.2: Shaper   **5 Hrs**

Introduction - specifications - principles of operations - standard shaper - quick return mechanism - crank and slotted link - hydraulic shaper - feed mechanism - operations.

Chapter 2.3: Slotter   **4 Hrs**

Introduction - specifications of planner - method of operation - Whitworth quick return mechanism - feed mechanism - types of tools.

Chapter 2.4: Broaching   **4 Hrs**

Types of broaching machine - horizontal, vertical and continuous broaching - principles of operation - types of broaches - classification - broach tool nomenclature - broaching operations.

UNIT - III
MILLING MACHINES AND GEAR GENERATING PROCESSES

Chapter 3.1: Milling Machines   **12 Hrs**

Types - column and knee type, plain, vertical and universal milling machines - principles of operation - specification of milling machines - work holding devices - tool holding devices - arbor - stub arbor - spring collet - adaptor. Milling cutters - cylindrical milling cutter - slitting cutter - side milling cutter - angle milling cutter - T slot milling cutter - woodruff milling cutter - fly cutter - nomenclature of cylindrical milling cutter. Milling operations - straddle milling - gang milling - vertical milling attachment. Indexing plate - differential indexing - simple indexing and compound indexing - simple problems.

Chapter 3.2: Generating Processes   **6 Hrs**

Gear shaper - gear hobbing - gear planning - principle of operations only. Gear finishing processes - burnishing - shaving - grinding and lapping - gear materials.

UNIT - IV
UNCONVENTIONAL MACHINING PROCESSES

Chapter 4.1: Mechanical Energy Based Processes   **6 Hrs**

Introduction - classification - process selection - advantages - limitations - demerits of conventional processes. Mechanical energy based process: Introduction - abrasive jet machining - metal removal rate process parameters - water jet machining - hydrodynamic jet machining - ultrasonic machining process - advantages - disadvantages - applications - compare ultrasonic machining with traditional abrasive machining.

Chapter 4.2: Electrical Energy Based Processes   **6 Hrs**

Introduction - Electrical Discharge Machine (EDM) - flushing system in EDM - tool (electrode) materials - tool wear - metal removal rate and surface finish - factors affecting the metal removal rate - advantages - disadvantages - applications - wire cut EDM, features of wire cut EDM - difference between EDM and wire cut EDM.

Chapter 4.3: Thermal Energy Based Processes   **6 Hrs**

Introduction - electron beam machining - laser beam machining - lasing materials - machining applications of laser - plasma arc machining - gases used in plasma arc machining - types of plasma arc torches - advantages - disadvantages - applications.

UNIT - V
CNC MACHINE AND CNC PROGRAMMING

Chapter 5.1: CNC Machines   **6 Hrs**

Numerical control - definition - working principle of a CNC system - features of CNC machines - advantages of CNC machines - difference between NC and CNC - construction and working principle of turning centre - construction and working principle of machining centre machine axes conventions turning centre and machining centre - coordinate measuring machine - construction and working principle.

Chapter 5.2: Components of CNC Machine   **5 Hrs**

Slide ways - requirement - types - friction slide ways and anti-friction slide ways - linear motion bearing - recirculation ball screw - ATC - tool magazine - feedback devices - linear and rotary transducers - encoders - in-process probing - tool material - tool inserts.

Chapter 5.3: CNC Programming   6 Hrs

Introduction - Cartesian coordinate system - Polar coordinate system - Absolute and incremental positioning - purpose of G and M codes. Basic codes - basic CNC program - CNC turning program using linear interpolation and circular interpolation. Machine control panel - homing position - offset setting - Auto CNC milling program using linear interpolation and circular interpolation. Compensation - machine control panel - home position - work offset setting procedure - tool offset.

Reference Books:

1. Elements of Workshop Technology- Vol. I & II, Hajra Choudry & Battacharya, Edn. 11, Media Promoters and Publishers Pvt. Ltd., Mumbai, 2007.
2. Production Technology, Jain & Gupta, Khanna Publishers, New Delhi, 2006.
3. Manufacturing process, Myro N Begma, Ed. 5, Tata McGraw Hill, New Delhi 110 008.
4. Workshop Tech Vol I,II, III, WAJ. Chapman, published by Viva Books Pvt. Ltd.,New Delhi.
5. Production Technology, OP Khanna, Vol.2, Dhanpat Rai Pub, New Delhi, 1999

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6243 - THERMAL ENGINEERING - I
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION				
	Hrs / Week	Hrs / Sem	Marks				Duration
6243 THERMAL ENGINEERING - I	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**		**Duration**
			25	100	100		3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
BASICS OF THERMODYNAMICS AND THERMODYNAMIC PROCESSES OF PERFECT GASES

Chapter 1.1: Basics of Thermodynamics   6 Hrs

Introduction - definitions and units of mass, weight, volume, density, work -power- energy - types - specific weight, specific gravity and specific volume - pressure - units of pressure - temperature - absolute temperature - STP and NTP conditions - heat - specific heat capacity at constant volume and at constant pressure - law of conservation of energy - thermodynamic system - types - thermodynamic equilibrium - properties of systems - intensive and extensive properties - state of system - process - cycle - point and path functions - zeroth, first and second laws of thermodynamics - description of basic concepts only.

Chapter 1.2: Perfect Gases   6 Hrs

Perfect gases - laws of perfect gases - Boyle's, Charles', Joule's, Regnault's and Avogadro's laws - general gas equation - characteristic gas equation - relation between specific heats and gas constant - universal gas constant - thermodynamic processes- change in internal energy - enthalpy - change in enthalpy - entropy - change in entropy - general equations for change in entropy - description only.

Chapter 1.3: Thermodynamic Processes of Perfect Gases   6 Hrs

Constant volume, constant pressure, isothermal, isentropic (reversible adiabatic) - description and problems - polytropic (derivation only), hyperbolic (derivation only) - PV and TS diagrams - work done - change in internal energy - heat transfer - change in enthalpy - change in entropy for various processes - free expansion and throttling processes.

UNIT - II
THERMODYNAMIC AIR CYCLES AND HEAT TRANSFER
Chapter 2.1: Thermodynamic Air Cycles   9 Hrs

Air cycles - air standard efficiency - reversible and irreversible processes - assumptions in deriving air standard efficiency - Carnot cycle - Otto cycle - Joule cycle - diesel cycle - comparison of Otto   cycle and diesel cycle - comparison of ideal and actual p-V diagrams of Otto and diesel cycles - problems.

Chapter 2.2: Heat Transfer   9 Hrs

Modes of heat transfer - heat transfer by conduction - Fourier's law - heat transfer by convection - heat exchanger - parallel flow and counter flow - heat transfer by radiation - description only - steady flow system - control volume - steady flow energy equation - assumptions - engineering   applications   of steady flow energy - non-flow energy equation. (description only). - LMTD - heat conduction through plane and composite walls - heat conduction through a cylinder - problems.

UNIT - III
INTERNAL COMBUSTION ENGINES

Chapter 3.1: Classification and Comparison of IC Engines   6 Hrs

Internal combustion engines - classifications of IC engines - components of IC engines and functions - material and method of manufacturing - four stroke cycle petrol and diesel engines - two stroke cycle petrol and diesel engines - comparison of four stroke and two stroke engines of petrol and diesel engines - valve timing diagram for four stroke petrol and diesel engines - port timing diagram for two stroke petrol and diesel engines.

Chapter 3.2: Fuel Supply System   6 Hrs

Layout of fuel supply system in petrol engines - AC mechanical fuel pump - simple carburetor - layout of fuel supply system in diesel engine - single acting fuel feed pump - CAV fuel injection pump - fuel injectors - types of nozzles - fuel filters - ignition systems - battery coil ignition systems - magneto ignition system - MPFI and CRDI system.

Chapter 3.3: Cooling and Lubrication System   6 Hrs

Governing of IC engines - quantity and quality governing - cooling systems - air cooling - water cooling. Lubrication system - properties of lubricants - types of lubrication systems - high pressure lubrication system - oil pump (gear & rotor pumps) and oil filters.

UNIT - IV
FUELS & COMBUSTION OF FUELS AND PERFORMANCE OF IC ENGINES
Chapter 4.1: Fuels & Combustion of Fuels   10 Hrs

Classifications of fuels - merits and demerits - requirements of a good fuel - combustion equations - stoichiometric air required for complete combustion of fuels - excess air - products of combustion - analysis of exhaust gases - exhaust gas analyser - calorific value of fuels - higher and lower calorific values - Dulong's formula - determination of calorific value - Bomb and Junker's calorimeter. (description only).

Chapter 4.2: Performance of IC Engines   8 Hrs

Testing - thermodynamic and commercial tests - indicated power - brake power - friction power - efficiencies of IC engines - indicated thermal, brake thermal, mechanical and relative efficiencies - specific fuel consumption - problems - Morse test - heat balance sheet - procedure and problems.

UNIT - V
REFRIGERATION AND AIR CONDITIONING
Chapter 5.1: Refrigeration   9 Hrs

Refrigeration - refrigerators and heat pumps - types and applications of refrigeration systems - refrigerating effect - unit of refrigeration - COP - actual COP - air refrigeration system - reversed Carnot cycle - COP of refrigerator, heat pump & heat engines - Bell- Coleman cycle - vapour compression refrigeration system - vapour absorption system - comparison - refrigerants - properties (description only).

Chapter 5.2: Air Conditioning   8 Hrs

Psychrometry - psychometric properties - dry air - moist air - water vapour - saturated air - dry bulb temperature - wet bulb temperature - wet bulb depression - dew point temperature - dew point depression - humidity - specific and relative humidity - psychrometric chart - psychrometric processes - sensible heating and cooling - by-pass factor - humidification - dehumidification - mixing of air stream. Air conditioning - classification and applications of air conditioning system -

room air conditioning - central air conditioning - comparison - comfort and industrial air conditioning - factors to be considered in air conditioning - loads encountered in air conditioning systems. (description only).

Reference Books:
1. Thermal Engineering, RK Rajput, 8th Edition, Laxmi publications Pvt Ltd, New Delhi.
2. Applied Thermodynamics, PK Nag, 2nd Edition, TATA Mcgraw - Hill Publishing Co. New Delhi .
3. Thermal Engineering, RS Khurmi and J.K. Gupta, 18th Edition, S Chand & Co, New Delhi.
4. Thermal Engineering, PL Ballaney , 24th Edition Khanna Publishers, NewDelhi.
5. Thermal Engineering, BK. Sarkar , 3rd Edition , Dhanpat Rai & Sons NewDelhi .
6. Applied Thermodynamics, Domkundwar & CP Kothandaraman, 2ndEd. Khanna publisher, New Delhi.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6244 - PRODUCTION AND QUALITY MANAGEMENT
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6244 PRODUCTION AND QUALITY MANAGEMENT	5 Hrs	80 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Topics and Allocation of Hours

Unit No	Topics	Hours
I	Process Planning, Selection and Production Planning	15
II	Basic Concepts of Total Quality Management	14
III	TQM Tools	14
IV	Statistical Fundamentals, Control Charts and QMS	15
V	Lean Manufacturing Concepts	15
Test and Model Examinations		07
Total		**80**

DETAILED SYLLABUS
UNIT - I
PROCESS PLANNING, SELECTION AND PRODUCTION PLANNING
Chapter 1.1: Production: 3 Hrs
Plant - plant layout - types of plant layout - production - definition - types of production - mass production, batch production and job order production - advantages and disadvantages.
Chapter 1.2: Process Planning: 6 Hrs
Introduction - concept - Information required to do process planning- factors affecting process planning - process planning procedure - make (or) buy decision using break even analysis - simple problems - manual process planning - Introduction of automated process planning - Advantage of computer aided process planning - principle of line balancing - need for line balancing - value engineering - definition - cost control Vs cost reduction - value analysis when to do - steps information needed - selection of product.

Chapter 1.3: Process Selection: 6 Hrs
Process selection - technological choice - specific component choice - process flow choice - factors affecting process selection - machine capacity - analysis of machine capacity - process and equipment selection procedure - determination of man, machine and material requirements - simple problems - selection of material - jigs - fixtures etc. - factors influencing choice of

machinery - selection of machinery - simple problems - preparation of operation planning sheet for simple components - production planning - major functions of production planning.

UNIT - II
BASIC CONCEPTS OF TOTAL QUALITY MANAGEMENT
Chapter 2.1: Basic Concepts   7 Hrs
Quality - definitions - dimensions of quality - brainstorming and its objectives - introduction to TQM - characteristics - basic concepts - elements - pillars - principles - obstacles to TQM implementation - potential benefits of TQM.
Chapter 2.2: TQM Concepts   7 Hrs
Quality council - duties - responsibilities - quality statements - vision - mission - quality policy statements - strategic planning - seven steps to strategic planning - deming philosophy - customer - input / output process model - customer perception of quality - customer retention - Juran trilogy - PDCA (Deming wheel) cycle.

UNIT - III
TQM TOOLS
Chapter 3.1: Seven tools of quality control (Q7 tools):   7 Hrs
Check sheet - types of check sheet - histogram - cause and effect diagram - Pareto diagram - stratification analysis - scatter diagram - graph / run charts - control charts - construction of above diagrams. Quality circle - concept of quality circle - organisation of quality circle and objectives of quality circle - poka yoke - definition - steps - benefits of poka yoke implementation - zero defect concepts.
Chapter 3.2: Management Planning Tools (M7 Tools)   7 Hrs
Affinity diagram - radar diagram - inter relationship diagram (inter relationship diagram) - tree diagram - prioritization matrix - matrix diagram - decision tree - arrow diagram - matrix data analysis diagram - construction of above diagrams.

UNIT - IV
STATISTICAL FUNDAMENTALS, CONTROL CHARTS AND QMS
Chapter 4.1: Statistical Fundamentals   6 Hrs
Types of data - collection of data - classification of data - tabular presentation of data - graphical representation of a frequency distribution - comparison of frequency distribution - mean - median - mode - comparison of measures of central tendency - introduction to measures of dispersion - sample - sampling - normal curve - sigma - concept of six sigma - principles - process - problems.
Chapter 4.2: Control Charts   5 Hrs
Control chart - types of control charts - control chart for variables - construction of X bar and R charts - control limits Vs specification limits - process capability - method of doing process capability analysis - measures of process capability - problems. Attributes - control charts - P chart - np chart - c chart - u chart - construction of above diagrams - problems - comparison between variable chart and attribute chart - acceptance sampling - single sampling plan - double sampling plan.
Chapter 4.3: Quality Management System   4 Hrs
Quality Management System - introduction - benefits of ISO registration - ISO 9000 series of standards - ISO 9000 quality certification procedures - ISO 9001 requirements - implementation.

UNIT - V
LEAN MANUFACTURING CONCEPTS
Chapter 5.1: Lean Manufacturing Concepts   15 Hrs
5S concepts (SEIRI, SEITON, SEISO, SEIKETSU and SHITSUKE) - needs and objectives - effective implementation of 5S concepts in an organisation - house keeping - Kaizen - Kanban system - benchmarking - objectives of benchmarking - types - benchmarking process - benefits of benchmarking - pit falls of benchmarking - Just In Time (JIT) - concepts and its objectives - Total Productive Maintenance (TPM) - Introduction - objectives of TPM - steps in implementing TPM. - Overall Equipment Effectiveness (OEE) - Lean Six Sigma - Value Stream Mapping - DMAIC (Define, Measure, Analyse, Improve, Control) - DMADV (Define, Measure, Analyse, Design, Verify) - concepts of Failure Mode and Effect Analysis (FMEA).

Reference Books:

1. Industrial Engineering & Management - O.P Khanna
2. Industrial Engineering & Production Management - Martand Telsang
3. Total Quality Management, Dale H.Besterfield, Pearson Education Asia.
4. Total Quality Management, V.Jayakumar, Lakshmi Publications.(reprint 2005)
5. Training manual on ISO 9001 : 2000 & TQM, Girdhar J.Gyani, RajPublishingHouse, 2nd Edition 2001
6. Quality Management, Howard Cuitlow, Tata Mc Graw Hill, 1998
7. Production Engineering - P.C.Sharma.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6245 - STRENGTH OF MATERIALS AND FLUID MECHANICS PRACTICAL
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6245 STRENGTH OF MATERIALS AND FLUID MECHANICS PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXPERIMENTS:
PART - A: STRENGTH OF MATERIALS LABORATORY   **32 Hrs**

1. **Test on Ductile Materials:**
Finding Young's Modulus of Elasticity, yield points, percentage elongation and percentage reduction in area, stress strain diagram plotting, tests on mild steel.
2. **Hardness Test:**
Determination of Rockwell's Hardness number for various materials like mild steel, high carbon steel, brass, copper and aluminium.
3. **Torsion test:**
Torsion test on mild steel - relation between torque and angle of twist - determination of shear modulus and shear stress.
4. **Impact test:**
Finding the resistance of materials to impact loads by Izod test and Charpy test.
5. **Tests on springs of circular section:**
Determination of modulus of rigidity, strain energy, shear stress and stiffness by load deflection method (open or closed coil spring)
6. **Shear test:**
Single or double shear test on MS bar to finding the resistance of material to shear load.

PART - B: FLUID MECHANICS LABORATORY   **32 Hrs**

1. Verify the Bernoulli's theorem.
2. Determination of co-efficient of discharge of a mouth piece by variable head method.
3. Determination of co-efficient of discharge of a venturimeter.
4. Determination of the friction factor in a pipe.
5. Performance test on reciprocating pump and to draw the characteristics curves.
6. Performance test on centrifugal pump and to draw the characteristics curves.
7. Study on impulse turbine to find the performances. (Not for Examinations)
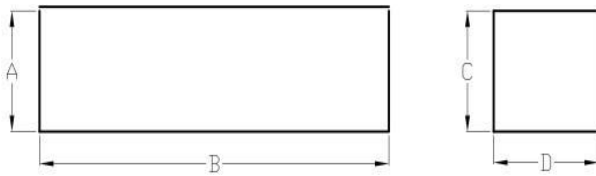
AUTONOMOUS EXAMINATION
Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Procedure / Observation	10
2	Tabulation / Calculations	25
3	Result / Graph	10
Part - B		
4	Procedure / Observation	10
5	Tabulation / Calculations	25
6	Result / Graph	10
7	Viva-voce	10
Total		**100**

6246 - MANUFACTURING TECHNOLOGY - II PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6246 MANUFACTURING TECHNOLOGY - II PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	4 Hrs	64 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

EXERCISES: **Raw Material: MS / CI   64 Hrs**

1. Make 'V' Block using vertical milling machine.

2. Make dovetail using horizontal milling machine.

3. Make groove cut using slotting machine.

4. Make round to hexagon in horizontal milling machine.

Dimensions			
Sl.No	Part Name	Actual	Obtained

5. Make spur gear using universal milling machine.

Dimensions			
Sl.No	Part Name	Actual	Obtained

6. Make helical gear using universal milling machine.

Dimensions			
Sl.No	Part Name	Actual	Obtained

7. Make slot cut using horizontal milling machine.

Dimensions			
Sl.No	Part Name	Actual	Obtained

8. Make progressive type plug gauge using cyl

9. M grin

Dimensions			
Sl.No	Part Name	Actual	Obtained

10. Make plain surfaces (four surfaces) using surface grinder.

Dimensions			
Sl.No	Part Name	Actual	Obtained

11. Drilling exercise in DRO vertical milling machine.
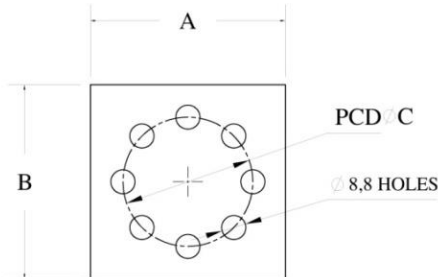
Dimensions			
Sl.No	Part Name	Actual	Obtained

12. Make the component in the CNC turing centre.
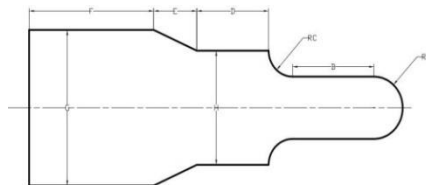
13. Make the component in the CNC milling centre.

DETAILED ALLOCATION OF MARKS

Sl. No.	Description	Marks
1	Procedure	10
2	Preparation of the Specimen	15
3	Setting and Machining	30
4	Dimensions	25
5	Finishing	10
	Viva-voce	10
Total		**100**

6247 - MEASUREMENTS AND METROLOGY PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6247 MEASUREMENTS AND METROLOGY PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXERCISES:

PART – A   **32 Hrs**

1. Measure the dimensions of ground MS flat / cylindrical bush using vernier caliper compare with Digital / Dial vernier caliper.
2. Measure the diameter of a wire and thickness of a plate using micrometer and compare the result with digital micrometer.
3. Measure the thickness of ground MS plates using slip gauges.
4. Measure the inside diameter of the bore of a bush cylindrical component and slot width of a component using inside micrometer compare the result with digital micrometer.
5. Measure the height of stepped blocks or parallel bars using vernier height gauge.
6. Detect of cracks of the given two specimens using liquid penetrant test and magnetic particle test.

PART – B   **32 Hrs**

1. Measure the angle of a V-block / Taper shank of Drill / Dovetail using universal bevel protractor.
2. Measure the angle of the machined surface using sine bar with slip gauges.
3. Measure the geometrical dimensions of V-Thread using thread micrometer.
4. Measure the geometrical dimensions of a spur gear.
5. Find out the measurement of given component and compare with a standard component using mechanical comparator and slip gauge.
6. Prepare a specimen to examine and find the grain structure using the metallurgical microscope.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Procedure / Least count	10
2	Observation / Readings / Calculation	25
3	Finishing	10
Part - B		
4	Procedure / Preparation	10
5	Observation / Readings / Calculation	25
6	Finishing	10
7	Viva-voce	10
Total		**100**

FIFTH SEMESTER
6251 - DESIGN OF MACHINE ELEMENTS

SUBJECT	INSTRUCTION		EXAMINATION			
6251 DESIGN OF MACHINE ELEMENTS	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
DESIGN ASPECTS OF ENGINEERING MATERIALS AND JOINTS
Chapter 1.1: Design Aspects of Engineering Materials   10 Hrs
General considerations in machine design - engineering materials - factors affecting selection of material - BIS designation of ferrous materials - preferred number - factor of safety and allowable stress - Stresses: tension, compression, shear, bearing pressure intensity, crushing, bending and torsion problem. creep strain and creep curve - fatigue, S-N curve, endurance limit - stress concentration - causes and remedies. Theories of elastic failures - principal normal stress theory, maximum shear stress theory and maximum distortion energy theory.

Chapter 1.2: Design Aspects of Joints   8 Hrs
Design of sleeve and cotter joint, knuckle joint and welded joint - fasteners - design of bolted joints - eye bolts - studs and pins.

UNIT - II
DESIGN OF SHAFTS, KEYS AND COUPLINGS
Chapter 2.1: Shafts   9 Hrs
Design of shafts subjected to - twisting moment - bending moment - combined twisting and bending moments - fluctuating loads - design of shafts based on rigidity.

Chapter 2.2: Keys and Couplings   9 Hrs
Types of keys - design of sunk keys only - effect of keyways on shaft - problems - requirements of good couplings - types - design of - rigid protected type flange couplings - marine couplings - pin type flexible coupling (description only).

UNIT - III
DESIGN OF FLAT BELTS AND V-BELTS
Chapter 3.1: Flat Belts   9 Hrs
Types of belts - materials for belt - types of belt drives - speed ratio - effect of slip - length of flat belts - tension ratio $T1/T2 = e^{\mu\theta}$ - centrifugal tension - power transmitted - condition for maximum power - transmission - Initial Tension - problems - design procedure of flat belts - design of flat belt based on manufacturer's data only - problems.

Chapter 3.2: V-Belts   9 Hrs
V-belt drive - comparison with flat belt drive - designation of V- belts - length of belt - power transmitted - design of V-belt using manufacturer's data only - problems.

UNIT - IV
DESIGN OF BEARINGS & SPUR GEARS
Chapter 4.1: Bearings   10 Hrs
Classifications of bearings - sliding contact and rolling contact bearings - radial and thrust bearings - roller bearing - types - designation of ball bearings - materials used for bearings - journal bearings - heat generated - heat dissipated - cooling oil requirement - problems - design of journal bearings - Problems. (design based on approved data books only).

Chapter 4.2: Spur Gears   8 Hrs
Gear drives - types of gears - applications - materials - spur gear terminology - design of spur gear based on Lewis and Buckingham equation (design procedure only) - speed reducer - types - worm gears - introduction - advantages and disadvantages - specification of pair of worm gears - materials for worm and worm wheel - basic dimensions of worm and worm gears (No problems in worm gear design)

UNIT - V
COMPUTER AIDED DESIGN (CAD) AND GEOMETRICAL MODELLING
Chapter 5.1: Computer Aided Design (CAD)   9 Hrs
CAD - roles of CAD in design - development and uses - applications - advantages - product cycle - design process - Shigley Model - Pahl and Beitz Model - sequential engineering - concurrent engineering - 2D and 3D transformation.

Chapter 5.2: Geometrical Modelling   8 Hrs
Solid modelling - entities - advantages and disadvantages - Boolean operations - Boundary representation - constructive solid geometry - comparison - finite element analysis - steps.

Reference Books:
- Machine Design, Pandya & Shah, Edn. 1995, Charotar Publishing House.
- Machine Design, TV. Sundararajamoorthy & N. Shanmugam, 2003, Anuradha Publications.
- Design Data Book, PSG College of Technology, DPV Printers.
- A text book of Machine Design, RS. Khurmi & JK.Gupta, Edn. 18, EurosiaPub. House Pvt. Lt.
- Theory and Problems of Machine Design, Holowenko, Laughlin, Schaum'soutline series.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6252 - THERMAL ENGINEERING - II

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6252 THERMAL ENGINEERING - II	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	7 Hrs	112 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS
UNIT - I
FORMATION AND PROPERTIES OF STEAM & THERMODYNAMIC PROCESSES OF VAPOUR
Chapter 1.1: Formation and Properties of Steam   13 Hrs
Steam - properties - formation of steam- saturation temperature- enthalpy of water - enthalpy of evaporation - conditions of steam - wet, dry and superheated steam - dryness fraction - enthalpy of wet, dry and superheated steam - advantages of superheated steam - property diagrams - p-V diagram - TH diagram - TV diagram - TS diagram - phase diagram - HS diagram - PH diagram - critical conditions of water - specific volume of water and steam - density of steam - external work done during evaporation - internal latent heat - internal energy of steam - entropy of water and steam - steam tables - Mollier chart - description only.

Chapter 1.2: Thermodynamic Processes of Vapour   8 Hrs
Determination of dryness fraction of steam - bucket calorimeter - combined separating and throttling calorimeters - problems - expansion processes of steam - constant volume, constant pressure, constant temperature, hyperbolic, polytrophic, isentropic and throttling processes - problems.

UNIT - II
STEAM BOILERS AND PERFORMANCE OF BOILER
Chapter 2.1: Steam Boilers   13 Hrs
Introduction - classification of boilers - comparison of fire tube and water tube boilers- high pressure boilers - advantages of high pressure boilers - BHEL high pressure boilers - boiler mountings and function - construction and working - boiler accessories and function - construction and working - comparison of mountings and accessories - feed water treatment - internal and external treatments - starting boiler from cold condition - safety precautions in boiler operation - clauses of Indian boiler act.

Chapter 2.2: Performance of Boiler   8 Hrs

Evaporation rate - actual, equivalent and factor of evaporation - boiler efficiency - factors influencing boiler efficiency - boiler power - problems - boiler plant - efficiency of economizer and super heater - problems - boiler trial - heat losses in a boiler- heat balance sheet - problems.

UNIT - III
THERMAL POWER PLANT, STEAM TURBINES AND CONDENSERS

Chapter 3.1: Thermal Power Plant   7 Hrs

Selection of site for thermal power plant - layout of thermal power plant - fuel and ash circuit - water and steam circuit - air and flue gas circuit - cooling water circuit - merits and demerits of thermal power plant - air pollution by thermal power plants - pollutants, effects and control - cyclone separator - wet scrubber - electrostatic precipitator - control of NO_2 and SO_2 - fluidised bed combustion - thermal and noise pollution.

Chapter 3.2: Steam Turbines   7 Hrs

Basic steam power cycles - Carnot, Rankine and modified Rankine cycles - classification of steam turbine - impulse and reaction turbines - difference - necessity of compounding - methods of compounding - special turbines.

Chapter 3.3: Condensers   7 Hrs

Steam condensers - elements of condensing plant - classification of condensers - jet condenser - surface condensers - comparison of jet and surface condensers - sources of air in condenser - condenser vacuum - vacuum efficiency - condenser efficiency - mass of cooling water required - mass of air present - number of tubes - simple problems.

UNIT - IV
SOURCES OF ENERGY AND NUCLEAR POWER PLANT

Chapter 4.1: Sources of Energy   8 Hrs

Conventional sources of energy - layout of hydel and diesel power plants - merits and demerits - non-conventional sources of energy - introduction - solar energy - solar power plants - merits and demerits.

Chapter 4.2: Nuclear Power Plant   13 Hrs

Nuclear fuels - fissile and fertile fuels - nuclear fission and fusion - chain reaction - radio activity - layout of nuclear power plant - merits and demerits - nuclear reactors - components - reactor core - moderators - control rods - coolant - reflectors - biological shield - reactor vessels - classification of reactor - pressurized water reactor - boiling water reactor - Candu type reactor - fast breeder reactor - effect of nuclear radiation - fuel cycle - site selection - safety - floating nuclear power plants - uranium enrichment - methods - disposal of nuclear wastes - comparison of nuclear power plants with thermal power plants - nuclear power plants in India.

UNIT - V
AIR COMPRESSORS AND GAS TURBINES

Chapter 5.1: Air Compressors   9 Hrs

Air compressors - uses of compressed air - classifications of air compressor reciprocating compressor - single stage reciprocating compressor - compression processes - power required to drive the compressor (neglecting clearance volume) - clearance volume and its effects - volumetric efficiency - power required to drive the compressor with clearance volume - problems - multi stage compression - merits and demerits - work input - ratio of cylinder diameters for minimum work input - rotary compressors - roots blower - vane blowers - centrifugal and axial flow air compressors.

Chapter 5.2: Gas Turbines   6 Hrs

Gas turbines - uses - classifications - merits and demerits of gas turbines -constant pressure combustion gas turbine - gas turbine with intercooler - reheater - regenerator - effects - closed cycle gas turbines - merits and demerits of open and closed cycle gas turbines.

Chapter 5.3: Jet propulsion   6 Hrs

Jet propulsion - turbojet engines - merits and demerits - turbo propeller engines - merits and demerits - ramjet - merits and demerits - Rocket engines - solid propellant rocket - applications of rockets.

Reference Books:

1. Thermal Engg, RK. Rajput, 8th Edition, Laxmi publications Pvt Ltd, New Delhi.
2. Applied Thermodynamics, PK. Nag, ,2nd Edition, Tata McGraw Hill Publishing Co., New Delhi
3. Thermal Engineering, RS. Khurmi and JK. Gupta, 18th Edition, S.Chand &Co, New Delhi
4. Thermal Engineering, P.L Ballaney , 24th Edition, Khanna Publishers, New Delhi.
5. Thermal Engineering, B.K. Sarkar , 3rd Edition, Dhanpat Rai & Sons NewDelhi.
6. Applied Thermodynamics, Domkundwar & CP. Kothandaraman, 2ndEd., Khanna Publishers.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6253.1   ELECTIVE THEORY - I: AUTOMOBILE TECHNOLOGY

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6262 ELECTIVE THEORY - I: AUTOMOBILE TECHNOLOGY	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
AUTOMOBILE ENGINES
Chapter 1.1: Engine Components   **6 Hrs**
Basic engine components - functions - types - materials and construction of cylinder block - crank case - oil pan - cylinder head - gaskets - cylinder liners - comparison of liners - piston - piston rings - expansion control of piston - types of compression rings and oil control rings - piston pin - connecting rod - methods of connecting piston and connecting rod - crank shaft - flywheel - cam shaft - valve and valve mechanism - L - I - F - T engines.

Chapter 1.2: Cooling Systems   **6 Hrs**
Cooling systems - purpose - types - air and water cooling systems - merits and demerits - pump assisted water cooling systems - components - water pump, fan - thermostat - types - radiator - types - pressure cap - vapour recovery cooling system - vented and pressurized expansion tank - troubles in cooling system.

Chapter 1.3: Lubrication Systems   **6 Hrs**
Lubrication systems - purpose - types of lubricants - additives - service rating of oil - types of lubricating systems - full pressure system - techniques of cylinder and piston lubrication - oil pump - oil filters - full flow and bypass filter systems - troubles in lubrication system.

UNIT - II
FUEL FEED SYSTEMS AND ALTERNATIVE FUELS
Chapter 2.1: Fuel Feed Systems   **12 Hrs**
Requirements of good fuel - types of fuel feed systems - SU electrical fuel pump - fuel filter - air cleaners - types - petrol injection - merits and demerits - DTSI - VTI - CCVTI - PGMFI - MPFI system. layout of diesel and petrol fuel feed system - single acting fuel feed pump - fuel injection pumps - construction and working of CAV fuel injection pump - construction and working of distributor type pump - CRDI system - fuel injectors - types - single and multi hole - pintle and pintaux - fuel filters - primary and secondary filters.

Chapter 2.2: Alternative Fuels   **6 Hrs**
Alcohol - hydrogen - compressed natural gas - liquefied petroleum gas and bio diesel - properties - suitability - merits and demerits - engine modifications.

UNIT - III
TRANSMISSION AND POWER TRAINS
Chapter 3.1: Power Transmission System   **4 Hrs**
General arrangement of power transmission system - arrangement of front engine rear drive - rear engine rear drive - front engine front drive - four wheel drive - applications.

Chapter 3.2: Clutch and Gear box   **5 Hrs**

Clutch - function - components - types - single plate, multi plate and diaphragm spring clutch - fluid coupling - clutch troubles and their causes. Gear box - purpose - various resistance to motion - types of gear boxes - constant mesh and synchromesh - gear box troubles and their causes.

Chapter 3.3: Drive line   4 Hrs
Drive line - propeller shaft - universal joint - cross type only - slip joint - final drive - function - types of gear arrangement - straight & spiral bevel, hypoid ,worm and worm wheel - merits , demerits and application - Hotch-kiss drive - torque tube drive - radius rod.

Chapter 3.4: Differential and Rear Axle   5 Hrs
Differential - purpose - construction and operation - self locking and non-slip differential - differential troubles and their causes - semi floating, three quarter floating and full floating rear axles.

UNIT - IV
AUTOMOBILE CHASSIS
Chapter 4.1: Front Axle and Steering   4 Hrs
Front axle - types - stub axle - types - steering system - Ackermann principle of steering - wheel alignment - factors - camber, caster, king pin inclination, toe in and toe out on turns - steering linkages - steering gears - cam and double roller, recirculating ball type, rack and pinion - steering troubles and causes - power steering - necessity - types - layout of any one type - collapsible steering system.

Chapter 4.2: Suspension System   5 Hrs
Suspension system - functions - type of springs - leaf, coil and torsion bar - front suspension systems - independent front suspension - merits and demerits - types - rear end suspension - air suspension - shock absorber - purpose - telescopic type –construction and working.

Chapter 4.3: Brake System   5 Hrs
Brake system - functions - classification of brakes - drum brakes - leading shoe and trailing shoe - self energizing action - hydraulic brake - brake bleeding - air assisted hydraulic brakes - air brake - layout - functions of each component and application only - disc brakes - construction and working - comparison of disc and drum type - brake troubles and their causes - anti lock brake system.

Chapter 4.4: Wheels and Tyres   4 Hrs
Wheels - types of wheels - brief description and applications - tyres - function- construction of tyres - cross and radial ply tyres - comparison - tyre inflation - nitrogen filled tyre.

UNIT - V
ELECTRICAL EQUIPMENT & HYBRID ELECTRIC VEHICLES
Chapter 5.1: Starting and Charging Circuits   6 Hrs
Battery - lead acid battery - Nickel alkaline battery - construction - battery rating - charging - testing - starting circuit - construction and operation of starter motor - starting motor drives - over running clutch and bendix drive - construction and operation - solenoid switch - charging circuit - alternator construction and operation - regulators - dynamo.

Chapter 5.2: Ignition and Lighting systems   6 Hrs
Ignition system - types - high tension magneto - electronic ignition - ignition system troubles and remedies - lighting system - circuit - head light - aiming and adjustment - sealed beam head lights - directional signal circuits - fluorescent lamp - horn circuits - wind screen wiper.

Chapter 5.3: Hybrid Vehicles   5 Hrs
Introduction - concept and environmental importance of EVs, HEVs and solar vehicles - electric vehicles - layout, construction and working - hybrid electric vehicles - types - layout - hybridization factor - plug in hybrid electric vehicles - fuel efficiency analysis - challenges and future scope of EVs and HEVs - emission standards - Euro I, II, III and IV norms - Bharat stage II, III, IV, VI norms - Motor Vehicle Act.

Reference Books:
1.   Automobile Engineering, GBS.Narang, Khanna Publishers, New Delhi.
2.   Automotive Mechanics, William H.Crouse and Donald .L. Anglin, TataMcGraw- Hill Pub.Co. Ltd,
3.   The Automobile, Harbans Singh Reyat, S.Chand &Co Ltd, New Delhi
4.   Vehicle and Engine Technology. Vol. I,Heinz Heisler, ELBS
5.   Automotive Mechanics,Joseph Heitner, East–west Press (P) Ltd, New Delhi

6. Internal Combustion Engines, M.L.Mathur &R.P.Sharma, Dhanpat Rai & Sons,
7. Electric & Hybrid Vehicle, A.K.babu, Khanna Publications, New Delhi.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6253.2 ELECTIVE THEORY - I:
GREEN ENERGY AND ENERGY CONSERVATION

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6253.2 ELECTIVE THEORY - I: GREEN ENERGY AND ENERGY CONSERVATION	Hrs / Week	Hrs / Sem	Marks			Duration
			Internal Assessment	External Exam*	Total	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
FUNDAMENTALS OF ENERGY, GEOTHERMAL ENERGY, WIND ENERGY

Chapter 1.1: Fundamentals of Energy **6 Hrs**

Introduction - energy need and trends - forms of energy - first law of thermodynamics - second law of thermodynamics - energy requirement and supply - fossil fuels and climate changes - need of renewable energy sources - current renewable energy uses - renewable energy policies in india.

Chapter 1.2: Geothermal Energy **6 Hrs**

Introduction - essential characteristic - sources - power plants - single flash power plant - double flash power plant - flow diagram and principle only.

Chapter 1.3: Wind Energy **6 Hrs**

Introduction - energy conversion - site selection considerations - components of wind energy conversion system - classification - wind mill - horizontal axis machines - vertical axis machines - working principle, advantages and disadvantages - schemes for electric generation.

UNIT - II
BIO MASS ENERGY AND SOLAR ENERGY

Chapter 2.1: Bio Mass Energy **9 Hrs**

Introduction - conversion technologies: Wet processes - dry processes - Bio gas generation - factors affecting the bio gas generation - classification of bio gas plants - Bio gas plant - construction - advantages and disadvantages. Materials used for bio gas generation - factors to be considered for the selection of site.

Chapter 2.2: Solar Energy **9 Hrs**

Introduction - Sun's energy - advantages - conversion challenges - The Sun - Earth movement - Solar radiation - different angles - optimal angle for fixed collector, in summer and winter. Sun tracking - measuring instruments of solar radiation - methods to estimate solar radiation.

UNIT - III
PHOTOVOLTAIC (PV) AND PRODUCTION OF Si WAFERS

Chapter 3.1: Photovoltaic (PV) **9 Hrs**

Semiconductors as solar cell - types of unit cells - electronic arrangement of silicon atom - intrinsic semiconductor - extrinsic semiconductor - description only. P-N junction diode - forward bias - reverse bias. Solar cell - characteristics - description of short circuit current, open circuit voltage, fill factor and efficiency - losses in solar cells. Growth of solar PV and silicon (Si) requirement - production of metallurgical grade (MGS) - production of electronic grade (EGS)

Chapter 3.2: Production of Si Wafers **9 Hrs**

Ingot making - mono crystalline - multi crystalline - wafer dicing. Si sheets - Solar grade silicon (SoG) refining processes - Si usage in solar PV. process flow of commercial Si cell technology -

description of saw damage removal and surface texturing - diffusion process - thin-film layers for anti reflection coating and surface passivation - metal contacts and their deposition

UNIT - IV
PV TECHNOLOGIES, BATTERIES AND APPLICATIONS
Chapter 4.1: PV Technologies   8 Hrs
Thin film technologies - materials for thin film technologies - Thin film deposition techniques: physical vapour deposition - evaporation - sputtering. chemical vapour deposition - low pressure - plasma enhanced. advantages of thin film Si solar cell technologies. Solar cell structures - substrate arrangement - super state arrangement. Solar PV module: series and parallel connections of cells - mismatch in cell / module- design and structure of PV module.
Chapter 4.2: Batteries   4 Hrs
Batteries for PV systems - factors affecting battery performance - DC to DC converters - charge controllers - DC to AC converter (inverter) (description only).
Chapter 4.3: Applications   6 Hrs
Flat plate collector - concentrating solar collectors - solar pond - solar water heating - space heating and cooling - solar pumping - solar cooking - solar green house. principle and applications only.

UNIT - V
ENERGY CONSERVATION
Chapter 5.1: Energy conservation   6 Hrs
Energy conservation act 2001 - power of state government to facilitate and enforce efficient use of energy and its conservation - finance, accounts and audit of bureau - penalties and adjudication - appellate tribunal for energy conservation.
Chapter 5.2 Guidelines   6 Hrs
Energy conservation guidelines for Industries by BEE, Govt of India - guidelines - heating, cooling and heat transfer - waste recovery and usage - conversion of heat to electricity - prevention of energy loss due to heat radiation and electric resistance - Industry energy management system.
Chapter 5.3 Policies   5 Hrs
Net-metering policies - Tamil Nadu Energy Development Agencies - projects in Tami Nadu: Solar energy, Bio energy and Wind energy - Tamil Nadu Solar Policy 2019.

Reference Books:
1. Non Conventional Energy Sources, G.D.Rai, Khanna Publishers.
2. Non Conventional Energy Sources and Utilisation, R.K.Rajput, S.Chand &Company Ltd.
3. Renewable Energy, Stephen Peake, Oxford press
4. Non Conventional Energy Resources, B.H.Khan, Tata Mc Graw Hill.
5. Industrial Energy Conservation- D. A. Ray- Pergaman Press
6. Energy Resource Management, Kirpal Singh Jogi, Sarup and sons.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6253.3   ELECTIVE THEORY - I: MECHATRONICS

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6253.3 ELECTIVE THEORY - I: MECHATRONICS	Hrs / Week	Hrs / Sem	Marks			Duration
			Internal Assessment	External Exam*	Total	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS
UNIT - I
SENSORS AND TRANSDUCERS
Chapter 1.1: Sensors & Transducers   18 Hrs

Introduction - systems - measurement systems - control systems - microprocessor based controllers - examples - mechatronics approach - measurement system terminology - displacement, position and proximity sensors - velocity and motion sensors - force sensors -fluid pressure sensors - flow sensors - liquid level sensors - temperature sensors - light sensors - selection of sensors - calibration of sensors.

UNIT - II
ACTUATION SYSTEMS
Chapter 2.1: Actuation Systems   9 Hrs
Mechanical actuation systems - types of motion - freedom and constraints - loading - gear trains - pawl and ratchet - belt and chaindrive - bearing - selection - ball and roller bearings - mechanical aspects of motor selection. electrical actuation systems - switches and relays - solenoids - DC motors - AC motors - stepper motors - specification and control of stepper motors.
Chapter 2.2: Servomotors   9 Hrs
DC servomotor and AC servomotor - pneumatic and hydraulic systems - power supplies - DCV - PCV - cylinders - rotary actuators.

UNIT - III
BASIC SYSTEM MODELS, INPUT / OUTPUT SYSTEMS
Chapter 3.1: Basic System Models, Input / Output Systems   18 Hrs
Mathematical model - introduction to mathematical model - mechanical system building blocks - electrical system building blocks - fluid system building blocks - thermal system building blocks. system model - engineering systems - rotational - translational systems - electro-mechanical system - hydro-mechanical system - interfacing - input / output ports - interface requirements: buffers, handshaking, polling and interrupts - serial interfacing - introduction to Pia - serial communications interface - example of interfacing of a seven-segment display with a decoder.

UNIT - IV
PROGRAMMABLE LOGIC CONTROLLER
Chapter 4.1: Programmable Logic Controller   18 Hrs
Definition - basic block diagram and structure of PLC - input / output processing - PLC programming: ladder diagram, logic functions, latching and sequencing - PLC mnemonics - timers, internal relays and counters - shift registers - master and jump controls - data handling - analog input / output - selection of PLC - sample ladder programs.

UNIT - V
DESIGN EXAMPLES & ADVANCED APPLICATIONS IN MECHATRONICS
Chapter 5.1: Design Examples & Advanced Applications   17 Hrs
Design process stages - traditional Vs mechatronics designs - possible design solutions - timed switch - wind screen wiper motion - bath room scale - case studies of mechatronics systems: a pick-and-place robot, car park barrier, car engine management system - automatic camera and automatic washing machine.
Sensors for condition - monitoring systems of production systems - examples of monitoring methods: vibration monitoring, temperature monitoring, wear behavior monitoring - Mechatronics control in automated manufacturing: monitoring of manufacturing processes, on-line quality monitoring, model based systems, hardware-in-the-loop simulation - supervisory control in manufacturing inspection - integration of heterogeneous systems.

References Books:
1.   W.Bolton, "Mechatronics", 2nd Edition 2001, Pearson Education, New Delhi.
2.   R.K.Rajput, A Text Book of Mechatronics, 1st Edition 2007, S.Chand & Co.Ltd., New Delhi.
3.   HMT, "Mechatronics", 1st Edition 1998, Tata McGraw Hill, New Delhi.
4.   Devdas Shetty & Kolk, "Mechatronics System Design", 1st Reprint, 2001, PWSPublish Co,Boston
5.   James H.Harter, "Electromechanics", 1st Edition 2003, Prentice-Hall of India,New Delhi.
6.   M.D.Singh & J.G.Joshi, "Mechatronics", 1st Edition 2006, Prentice-Hall ofIndia, New Delhi.

   * Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6254 - PROCESS AUTOMATION PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6254 PROCESS AUTOMATION PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	4 Hrs	64 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Exercises
PART - A: PNEUMATICS LABORATORY   16 Hrs

1. Direct operation of single and double acting cylinder.
2. Operation of double acting cylinder with quick exhaust valve.
3. Speed control of double acting cylinder using metering-in and metering-outcircuits.
4. Automatic operation of double acting cylinder in single cycle - using limit switch.

HYDRAULICS LABORATORY   16 Hrs

5. Direct operation of double acting cylinder.
6. Direct operation of hydraulic motor.
7. Speed control of double acting cylinder metering-in and metering-out control.

PART - B: PLC LABORATORY   32 Hrs

1. Direct operation of a motor using latching circuit.
2. Operation of a motor using 'AND' logic control.
3. Operation of a motor using 'OR' 'control.
4. On-Delay control of a motor and Off -Delay control of a motor.
5. Automatic operation of Double acting cylinder-single cycle-forward, time delay, return.
6. Automatic operation of Double acting cylinder-Multi cycle.
7. Sequential operation of double acting cylinder and a motor.

AUTONOMOUS EXAMINATION
Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
	Part - A	
1	Procedure / Circuit diagram	10
2	Identification of Components	15
3	Connection and execution	20
	Part - B	
4	Procedure / Circuit diagram	10
5	Ladder diagram / Programming	25
6	Execution	10
7	Viva-voce	10
Total		**100**

6255 - THERMAL ENGINEERING PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6255 THERMAL ENGINEERING PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXPERIMENTS:
PART – A   **32 Hrs**
1. Determine flash and fire point of the given oil using open cup and closed cupapparatus.
2. Determine the absolute viscosity of the given lubricating oil using Redwoodviscometer.
3. Determine the absolute viscosity of the given lubricating oil using Saybolt viscometer.
4. Port timing diagram of two stroke petrol engine
5. Valve time diagram for four stroke petrol engine.
6. Valve time diagram for four stroke diesel engine.

PART – B   **32 Hrs**
1. Load test (performance test) on four stroke petrol engine.
2. Load test (performance test) on four stroke diesel engine.
3. Morse test on multi-cylinder petrol engine.
4. Heat balance test on four stroke diesel / petrol engine.
5. Volumetric efficiency of air compressor.
6. Determination of COP of refrigeration system.
7. Thermal conductivity measurement using guarded plate apparatus.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Observation and Tabular Column	05
2	Calculations	20
3	Result / Graph	10
Part - B		
4	Observation and Tabular Column	10
5	Calculations	30
6	Result / Graph	15
7	Viva-voce	10
Total		**100**

6256.1 - ELECTIVE PRACTICAL - I
AUTOMOBILE TECHNOLOGY PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION	
6256.1	**Hrs / Week**	**Hrs / Sem**	**Marks**	**Duration**

ELECTIVE PRACTICAL - I AUTOMOBILE TECHNOLOGY PRACTICAL	4 Hrs	64 Hrs	Internal Assessment	External Exam*	Total	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Exercises:

PART – A   32 Hrs

1. Dismantling and assembling of four stroke petrol engine and identification of parts.
2. Dismantling and assembling of four stroke diesel engine and identification of parts.
3. Removing camshaft, replacing timing gears, removing valves, lapping and adjusting valve clearance.
4. Removing, servicing and replacing of fuel pump, oil pump & water pump.
5. Removing, servicing and MPFI system.
6. Dismantling and assembling of inline fuel injection pump / CRDI system.
7. Testing a battery with specific gravity test and charge the battery with constant amperage / voltage method.

PART – B   32 Hrs

1. Removing and replacing of pressure plate and clutch plate and fingers adjustment.
2. Dismantling, inspecting and assembling of constant mesh gear box and find out the gear ratios.
3. Dismantling, assembling and adjusting of steering gear box.
4. Dismantling, overhauling and assembling of starter motor / alternator
5. Tracing of automobile electrical system with respect to battery coil ignition system
6. Tracing of automobile electrical system with respect to horn relay circuit and explain with neat circuit diagram.
7. Tracing of automobile electrical system with respect to wiper circuit and explain with neat circuit diagram.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
	PART - A	
1	Dismantling Procedure	20
2	Tools Handling Methods	15
3	Assembly / Report	10
	PART - B	
4	Dismantling Procedure	20
5	Tools Handling Methods	15
6	Assembly / Report	10
7	Viva-voce	10
Total		**100**

6256.2   ELECTIVE PRACTICAL - I: GREEN ENERGYAND ENERGY CONSERVATION PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION	
6256.2	Hrs / Week	Hrs / Sem	Marks	Duration

ELECTIVE PRACTICAL - I: GREEN ENERGY AND ENERGY CONSERVATION PRACTICAL	4 Hrs	64 Hrs	Internal Assessment	External Exam*	Total	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXPERIMENTS:

PART A   32 Hrs

1. Study and demonstrate the I-V and P-V Characteristics of PV module with varying radiation and temperature level.
2. Study and demonstrate the I-V and P-V characteristics of series and parallel combination of PV modules.
3. Study and demonstrate the effect of shading on module output power.
4. Do a shading analysis on the site where solar PV system needs to be setup.
5. Study the wind power generation status in Tamilnadu.
6. Study the biogas generation status in Tamilnadu.

PART B   32 Hrs

1. Conduct experiment to show the effect of variation in tilt angle on PV module power.
2. Conduct the experiment to demonstrate the working of diode as Bypass diode and blocking diode.
3. Conduct the experiment to draw the charging and discharging characteristics of battery.
4. Conduct the experiment for the power flow calculations of stand-alone PV system of AC load with battery.
5. Conduct the experiment for the power flow calculations of standalone PV system of DC load with battery.
6. Conduct the experiment to determine the different electrical parameters of a monocrystalline and polycrystalline silicon solar panel.

AUTONOMOUS EXAMINATION

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A		
1	Study explanation	30
Part - B		
2	Procedure / Observation / Reading	15
3	Calculations	35
4	Result	10
5	Viva-voce	10
Total		**100**

6256.3   ELECTIVE PRACTICAL - I: MECHATRONICS PRACTICAL

Subject Code   :   6256.3
Semester   :   V
Subject Name   :   ELECTIVE PRACTICAL - I: MECHATRONICS PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6256.3 ELECTIVE PRACTICAL - I: MECHATRONICS	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	4 Hrs	64 Hrs	Internal Assessment	External Exam*	Total	

			25	100	100	3 Hrs
PRACTICAL						

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

ELECTRO PNEUMATICS:

Introduction to electro pneumatics - applications of pneumatics - pneumatic and electro pneumatic controllers - components and assemblies in the electrical signal control section: Power supply unit - push button and control switches - sensors for measuring displacement and pressure - relays and contactors. electrically actuated directional control valves - construction and mode of operation - functions - electrical connection of solenoid coils. Procedure for developing a control system.

ELECTRO HYDRAULICS:

Basic principles of electro hydraulics - function and use of electro hydraulic components - production and interpretation of standard hydraulic and electrical circuit diagrams

PROCESS CONTROL INSTRUMENTATION:

Process control - types of processes - structure of control system - controllers - digital controllers - types of process control - on/off control - analog control - digital control. Data Acquisition System (DAS) - Objectives of DAS - Types of DAS: single channel DAS - multichannel DAS - computer based DAS. Data loggers - block diagram of data loggers - control facilities in data logger - uses of data logger - different stages of direct digital control.

SCADA - fundamental principles of modern SCADA systems - SCADA hardware - SCADA software - landlines for SCADA - SCADA and local area networks - modem used in SCADA systems - remote terminal units. Human machine interface - components of HMI.

Distributed Control System (DCS) - Parts of DCS - layered structure of DCS - communication options in DCS. variable frequency drives - construction, working, operation, applications and specifications

EXPERIMENTS:
PART - A

(ELECTRO PNEUMATICS)   **16 Hrs**
1. Direct control of a 3/2 NC Single solenoid valve and a 3/2 NO Single solenoid valve
2. Direct control of a 5/2 single solenoid valve and a 5/2 double solenoid valve
3. Simple circuit using OR Logic and AND Logic
4. Limit switch and proximity switch application circuits

(ELECTRO HYDRAULICS)   **16 Hrs**
1. Sorting device using double acting cylinder, directly actuated, manually
2. Component selection on conveyor belt using double acting cylinder and directly actuated, manually
3. Lifting station using single acting cylinder and directly actuated, manually
4. Door control using double acting cylinder and interlocking

PART B
PROCESS CONTROL INSTRUMENTATION   **32 Hrs**
1. Wiring practice of HMI.
2. Design of HMI screen.
3. HMI Configuration and Interfacing with PLC and PC.
4. Configuring Alarms in SCADA.
5. Real time project development and interfacing with PLC.
6. Monitoring & Control of Pneumatic System using HMI.

<u>AUTONOMOUS EXAMINATION</u>

Note: All the exercises in both sections have to be completed. Two exercises will be given for examination by selecting one exercise from PART - A and one exercise from PART - B. All the exercises should be given in the question paper and students are allowed to select by a lot. All students should submit record notebook for the examination.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
Part - A: Electro Pneumatic circuit / Electro Hydraulic circuit (by lot)		
1	Circuit diagram	15
2	Components connections & execution	20
3	Output	10
Part - B: Process Control Instrumentation		
4	Circuit diagram	15
5	Execution and Programming	20
6	Output	10
7	Viva-voce	10
Total		**100**

6257 - ENTREPRENEURSHIP & STARTUPS

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6257 ENTREPRENEURSHIP & STARTUPS	4 Hrs	64 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I

ENTREPRENEURSHIP - INTRODUCTION AND PROCESS   **10 Hrs**

Concept, functions and importance - myths about entrepreneurship - pros and cons of entrepreneurship - process of entrepreneurship - benefits of entrepreneurship -, competencies and characteristics - ethical entrepreneurship - entrepreneurial values and attitudes - motivation - creativity - innovation - entrepreneurs as problem solvers - mindset of an employee and an entrepreneur - business failure - causes and remedies - role of networking in entrepreneurship.

UNIT - II

BUSINESS IDEA AND BANKING   **10 Hrs**

Types of business: manufacturing, trading and services - stakeholders: sellers, vendors and consumers - E-commerce business models - types of resources - human, capital and entrepreneurial tools - goals of business and goal setting - patent - copyright and intellectual property rights - negotiations - importance and methods - customer relations and vendor management - size and capital based classification of business enterprises - role of financial institutions - role of government policy - entrepreneurial support systems - incentive schemes for state Government - incentive schemes for central Government.

UNIT - III

STARTUPS, E-CELL AND SUCCESS STORIES   **10 Hrs**

Concept of incubation centres - activities of DIC - financial institutions and other relevance institutions - success stories of Indian and Global business legends - field visit to MSME's - various sources of information - learn to earn - startup and its stages - role of technology - E-commerce and social media - role of E-cell - E-cell to entrepreneurship.

UNIT - IV

PRICING AND COST ANALYSIS   **10 Hrs**

Calculation of unit of sale - unit price and unit cost - types of costs - variable and fixed - operational costs - break even analysis - finance basics – profit and loss statement - basics of taxation - concept of cash inflow and cash outflow - prepare a cash flow projection - pricing and factors

affecting pricing - understand the importance and preparation of income statement - launch strategies after pricing and proof of concept - branding - business name, logo, tag line - promotion strategy.

UNIT - V
BUSINESS PLAN PREPARATION 10 Hrs
Generation of ideas - business ideas vs. business opportunities - selecting the right, opportunity - product selection - new product development and analysis - feasibility study report - technical analysis, financialanalysis and commercial analysis - market research - concept, importance and process - marketing and sales strategy - digital marketing - social entrepreneurship - risk taking - concept - types of business risks.

FIELD VISIT AND PREPARATION OF CASE STUDY REPORT 14 Hrs

REFERNCE BOOKS:

1. Dr. G.K. Varshney, Fundamentals of Entrepreneurship, Sahitya BhawanPublications, Agra - 282002
2. Dr. G.K. Varshney, Business Regulatory Framework , Sahitya BhawanPublications, Agra - 282002
3. Robert D. Hisrich, Michael P. Peters, Dean A. Shepherd, Entrepreneurship , McGraw Hill (India) Private Limited, Noida - 201301
4. M.Scarborough, R.Cornwell, Essentials of Entrepreneurship and small business management, Pearson Education India, Noida - 201301
5. Charantimath Poornima M. Entrepreneurship Development and SmallBusiness Enterprises, Pearson

Evaluation Pattern (Internal Mark Allocation)

Assignment (Theory portion)*	10 marks
Seminar Presentation	10 marks
Attendance	05 marks
Total	**25 marks**

Note: * Two assignments should be given. The same must be evaluatedand converted to 10 marks. Each assignment should have five three mark questions and two five mark questions.

AUTONOMOUS EXAMINATION

The students should be taught all units and proper exposure and field visit also arranged. All the portions should be completed before examinations. The students should maintain theory assignments and seminar presentation and should submit during the Practical Examinations. The question paper consists of theory and practical portions. All students should write the answers for theory questions (45 Marks) and practical portions (55 Marks). All exercises should be given in the question paper and students are allowed to select by lot.

For Written Examination: Theory question and answers: 45 Marks
Ten questions will be asked for 3 marks each. Five questions from Unit 1 & Five questions from Unit 2. (10 x 3 = 30).
Three questions will be asked for 5 marks each. One question from Unit 1, One question from Unit 2 & One question from Unit 3. (3 x 5 = 15)

For Practical Examination:
The business plan / feasibility report or report on unit 4 & unit 5 should be submitted during the practical examinations. The same have to be evaluated for the report submission (40 marks).

DETAILED ALLOCATION OF MARKS

Sl. No	Description	Marks
Part A	Written Examination - theory question and answer 10 questions x 3 marks = 30 marks 03 questions x 5 marks = 15 marks	45
Part B	Practical Examination - submission on business plan / feasibility report or report	40
Part C	Viva-voce	15
	Total	**100**

SIXTH SEMESTER
6261 - INDUSTRIAL ENGINEERING AND MANAGEMENT

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6261 INDUSTRIAL ENGINEERING AND MANAGEMENT	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

UNIT - I
PLANT ENGINEERING AND PLANT SAFETY
Chapter 1.1: Plant Engineering **9 Hrs**

Plant - selection of site of industry - plant layout - principles of a good layout - types - process, product and fixed position - techniques to improve layout - principles of material handling equipment - plant maintenance - importance - break down maintenance, preventive maintenance and scheduled maintenance.

Chapter 1.2: Plant Safety **9 Hrs**

Importance - accident - causes and cost of an accident - accident proneness - prevention of accidents - Industrial disputes - settlement of Industrial disputes - collective bargaining, conciliation, mediation, arbitration - Indian Factories Act 1948 and its provisions related to health, welfare and safety.

UNIT - II
WORK STUDY, METHOD STUDY AND WORK MEASUREMENT
Chapter 2.1: Work Study **4 Hrs**

Productivity - standard of living - method of improving productivity - objectives - importance of good working conditions

Chapter 2.2: Method Study **6 Hrs**

Definition - objectives - selection of a job for method study - basic procedure for conduct of method study - tools used - operation process chart, flow process chart, two handed process chart, man machine chart, string diagram and flow diagram.

Chapter 2.3: Work Measurement **8 Hrs**

Definition - basic procedure in making a time study - employees rating factor - application of time allowances - rest, personal, process, special and policy allowances - calculation of standard time - problems - basic concept of production study - techniques of work measurement - ratio delay study, synthesis from standard data, analytical estimating and Pre-determined Motion Time System (PMTS).

UNIT - III
HUMAN RESOURCE MANAGEMENT AND ORGANIZATIONAL BEHAVIOR
Chapter 3.1: Principles of Management **7 Hrs**

Definition of management - administration - organization - FW Taylor's and Henry Fayol's principles of management - functions of manager - directing - leadership - types of leadership - qualities of a good leader - motivation - positive and negative motivation - modern management techniques - management information systems - strategic management - SWOT analysis - Business Process Re-engineering (BPR) - Enterprises Resource Planning (ERP) - Activity Based Management (ABM) - global perspective - principles and brief description.

Chapter 3.2: Human Resource Management **6 Hrs**

Responsibility of human resource management - selection procedure - training of workers - apprentice training - on the job training and vestibule school training - job evaluation and merit rating - objectives and importance - wages and salary administration - components of wages -

wage fixation - type of wage payment - Halsey's 50% plan, Rowan's plan and Emerson's efficiency plan - problems.

Chapter 3.3: Organizational Behavior   5 Hrs

Definition - organization - types of organization - line, staff, Taylor's pure functional types - line and staff and committee type - organizational approaches, individual behavior - causes - environmental effect - behavior and performance, perception - organizational implications.

UNIT - IV
FINANCIAL AND MATERIAL MANAGEMENT
Chapter 4.1: Financial Management   9 Hrs

fixed and working capital - resources of capital - shares preference and equity shares - debentures - type of debentures - public deposits, factory costing - direct cost - indirect cost - factory overhead - selling price of a product - profit - problems. Depreciation - causes - methods - straight line, sinking fund and percentage on diminishing value method - problems.

Chapter 4.2: Material Management   9 Hrs

Objectives of good stock control system - ABC analysis of inventory - procurement and consumption cycle - minimum stock - lead time - reorder level - economic order quantity - problems - supply chain management - introduction - purchasing procedure - store keeping - classification of stores - functions of store keeper - stores management - bin card - store ledgers - codification of stores.

UNIT - V
HUMAN VALUES AND ENGINEERING ETHICS
Chapter 5.1: Human Values   8 Hrs

Morals - values - integrity - service learning - civic virtue - respect for others - living peacefully - caring - sharing - honesty - courage - valuing time cooperation - commitments - empathy - self confidence - character - stress management.

Chapter 5.2: Engineering Ethics   9 Hrs

Definition - engineering ethics - personal and business ethics - duties and rights - engineering as a profession - core qualities of professional practitioners - environment and their impact - code of ethics - procedure for solving ethical conflicts - ethical judgment - Kohlberg's stages of moral development - value based ethics - engineers as managers, consultants and leaders - environmental ethics - computer ethics - Intellectual Property Rights (IPRs).

Reference Books:
1. Industrial Engineering and Management, OP. Khanna, Dhanpat Rai Pub, 2004, New Delhi.
2. Engineering Economics and Management, TR. Banga & SC. Sharma, McGraw Hill Ed. 2, 2001.
3. Essentials of Management, Herald Koontz and Heinz Weihrich, McGraw Hill,Singapore Int. Edition.
4. Engineering Ethics, M. Govindarajan, S. Natarajan. VV.Senthilkumar, Prentice Hall of India - 2004.
5. Management - A Global Perspective, Heinz Weihrich, Harold Koontz, 10th Ed. McGraw Hill Int..
6. Essentials of Management, Joseph L. Massie, 4th Edition, Prentice Hall of India, New Delhi, 2004.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6262 - E- VEHICLE TECHNOLOGY AND POLICY
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6262 E- VEHICLE TECHNOLOGY AND POLICY	5 Hrs	80 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

UNIT - I
ENVIRONMENTAL IMPACT AND HISTORY, TYPES OF ELECTRIC VEHICLES
Chapter 1.1: Environmental Impact and History   7 Hrs

Environmental impact of conventional vehicle - air pollution - petroleum resources - history of electric vehicles & hybrid electric vehicles - conventional drive train system - rear wheel, front wheel and all wheel - parts of drive train system.

Chapter 1.2: Types of Electric Vehicles   8 Hrs

Introduction to Battery Electric Vehicle (BEV) - definition of BEV - necessity of BEV - Different between BEV and conventional vehicle - advantages of BEV - block diagram of BEV - Hybrid Electric Vehicle (HEV) - Plug-in Hybrid Electric Vehicle (PHEV) - Fuel Cell Electric Vehicle (FCEV) - description.

UNIT - II
ELECTRIC VEHICLE, ELECTRICAL PROPULSION SYSTEM

Chapter 2.1: Electric Vehicles   8 Hrs

Configurations of electric vehicle - performance of electric vehicles - tractive effort in normal driving - energy consumption. Hybrid Electric Vehicles: concept of hybrid electric drive trains - architecture of hybrid electric drive trains - series, parallel and series & parallel.

Chapter 2.2: Electric Propulsion Systems   7 Hrs

Types of EV motors - DC motor drives - Permanent Magnetic Brushless DC Motor Drives (BLDC) - principles, construction and working - hub motor drive system - merits and demerits of DC motor drive - BLDC motor drive.

UNIT - III
ENERGY STORAGES, CHARGING SYSTEM, EFFECTS AND IMPACTS

Chapter 3.1: Energy Storages   7 Hrs

electrochemical batteries - battery technologies - construction and working of lead acid batteries, nickel based batteries and lithium based batteries - role of Battery Management System (BMS)- battery pack development technology - cell series and parallel connection to develop battery pack.

Chapter 3.2: Charging   6 Hrs

battery charging techniques - constant current and constant voltage, trickle charging - battery swapping techniques - DC charging - wireless charging - maintenance of battery pack - latest development in battery chemistry.

Chapter 3.3: Effects and Impacts   2 Hrs

Effects of EV - impacts on power grid - impacts on environment - impacts on economy.

UNIT - IV
ELECTRIC MOBILITY POLICY FRAME WORK

Chapter 4.1: Electric Mobility Policy Frame Work   14 Hrs

Government of India Electric mobility policy frame work - Global scenario of EV adoption - electric mobility in India - National Electric Mobility Mission Plan 2020 - action led by original equipment manufacturers - need of EV policy - advantage of EV eco system - scope and applicability of EV policy - ARAI standards for electric vehicle - AIS 038, AIS 039 & AIS 123 - key performance indicator - global impact - trends and future developments.

UNIT - V
TAMILNADU E-VEHICLE POLICY 2019

Chapter 5.1: Tamil Nadu E-Vehicle Policy 2019   14 Hrs

Tamil Nadu E-vehicle policy 2019: Vehicle population in Tamil Nadu - objectives of EV policy - policy measures - demand side incentives - supply side incentives to promote EV manufacturing - revision of transport regulation of EV - city building codes - capacity building and skilling - charging structure - implementing agencies - research & development and business incubation - recycling ecosystem - battery and EVs.

Reference Books:

1. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York.
2. Comparison of Electric and Conventional Vehicles in Indian Market: Total Cost of Ownership, Consumer Preference and Best Segment for Electric Vehicle (IJSR), Akshat Bansal, Akriti Agarwal

3. A Comprehensive Study of Key Electric Vehicle (EV) Components, Technologies, Challenges, Impacts, and Future Direction of Development (MDPI), Fuad Un-Noor, Sanjeevikumar Padmanaban, Lucian Mihet-Popa, Mohammad Nurunnabi Mollah and Eklas Hossain.
4. Electric Vehicles: A future Projection CII October 2020 report.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6263.1 ELECTIVE THEORY - II: COMPUTER INTEGRATED MANUFACTURING

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6263.1 ELECTIVE THEORY - II: COMPUTER INTEGRATED MANUFACTURING	Hrs / Week	Hrs / Sem	Marks			Duration
	6 Hrs	96 Hrs	Internal Assessment	External Exam*	Total	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
COMPUTER AIDED DESIGN

Chapter 1.1: Computer Aided Design   7 Hrs
Computer Aided Design: Introduction - definition - Shigley's design process - CAD activities - benefits of CAD - CAD software packages - point   plotting, drawing of   lines - Bresenham's circle algorithm, Transformations: 2D & 3D transformations - translation, scaling, rotation and concatenation.

Chapter 1.2: Geometric Modelling   7 Hrs
Techniques: Wire frame modelling - applications - advantages and disadvantages. Surface modelling - types of surfaces - applications - advantages and disadvantages. Solid modelling - entities - advantages and   disadvantages - Boolean operations - boundary representation - constructive solid geometry - comparison.

Chapter 1.3: Graphics Standard   4 Hrs
Definition - need - GKS - IGES - DXF. Finite Element Analysis: introduction - development - basic steps - advantages.

UNIT - II
COMPUTER AIDED MANUFACTURING

Chapter 2.1: Computer Aided Manufacturing   4 Hrs
CAM - definition - functions of CAM - benefits of CAM. Introduction of CIM - concept of CIM - evolution of CIM - CIM wheel - benefits - integrated CAD/CAM.

Chapter 2.2: Group Technology   7 Hrs
Part families - parts classification and coding - coding structure - Opitz system, MICLASS system and CODE system. Process planning: Introduction - Computer Assisted Process Planning (CAPP) - types of CAPP - variant type - generative type - advantages of CAPP.

Chapter 2.3: Production Planning and Control (PPC)   7 Hrs
Definition - objectives - computer integrated production management system - Master Production Schedule (MPS) - capacity planning - Materials Requirement Planning (MRP) - Manufacturing Resources Planning (MRP-II) - Shop Floor Control system (SFC) - Just In Time manufacturing philosophy (JIT) - introduction to Enterprise Resources Planning (ERP).

UNIT - III
CNC PROGRAMMING

Chapter 3.1: CNC Programming   18 Hrs
Principles of CNC machines - configuration of CNC system - types of CNC machines - advantages and applications of CNC machines - feedback control system - open loop and closed loop control system - axis rotation of various CNC machines - NC in CAM - tooling for CNC - ISO designation for tooling - CNC operating system. Programming for CNC machining - part program - manual part programming - coordinate system.

Datum points: machine zero, work zero, tool zero - reference points - NC dimensioning - G codes and M codes - linear interpolation and circular interpolation - CNC program procedure - sub-program - canned cycles - stock removal - thread cutting- mirroring - drilling cycle - pocketing. Rapid prototyping: Classification - subtractive - additive - advantages and applications - materials - virtual machining.

UNIT - IV
ADVANCED CIM CONCEPTS
Chapter 4.1: FMS, AGV, AS / RS, Robotics   **7 Hrs**
FMS: Introduction - FMS components - FMS layouts - types of FMS: Flexible Manufacturing Cell (FMC) - Flexible Turning Cell (FTC) - Flexible Transfer Line (FTL) - Flexible Machining System (FMS) - benefits of FMS - introduction to intelligent manufacturing system.
Chapter 4.2: Material handling in CIM environment: **4 Hrs**
Types - AGV introduction - AGV - working principle - types - benefits. AS / RS - working principle - types - benefits.
Chapter 4.3: Robotics   **7 Hrs**
Definition - robot configurations - basic robot motion - robot programming method - robotic sensors - end effectors - mechanical grippers - vacuum grippers - robot programming concepts - industrial applications of robot - characteristics - material transfer and loading - welding - spray coating - assembly and inspection.

UNIT - V
MANUFACTURING CONCEPTS
Chapter 5.1: Manufacturing Concepts   **17 Hrs**
Concurrent Engineering: Definition - sequential Vs concurrent engineering - need of CE - benefits of CE. Quality Function Deployment (QFD): Definition - House of Quality (HOQ) - advantages - disadvantages. Steps in Failure Modes and Effects Analysis (FMEA) - Value Engineering (VE) - types of values - identification of poor value areas - techniques - benefits - guidelines of Design for Manufacture and Assembly (DFMA). Product development cycle - product life cycle - new product development processes - Augmented Reality (AR) - Introduction to IoT - concepts of 3D printing - basics of Industry 4.0 - applications.

REFERENCE BOOKS:
1. CAD/CAM/CIM, R.Radhakrishnan, and S.Subramanian, New AgeInternational Pvt. Ltd.
2. CAD/CAM, Mikell P.Groover, and Emory Zimmers, Jr. Prentice Hall of IndiaPvt., Ltd.
3. CAD/CAM Principles and Applications, Dr.P.N.Rao, Tata Mc Graw Hill Publishing Company Ltd.
4. Mastering CAD/CAM, Ibrahim Zeid, Tata McGraw-Hill Publishing Company Ltd., New Delhi.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6263.2 ELECTIVE THEORY - II: WELDING TECHNOLOGY

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6263.2 ELECTIVE THEORY - II: WELDING TECHNOLOGY	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.
DETAILED SYLLABUS

UNIT - I
WELDING PROCESSES AND EQUIPMENTS
Chapter 1.1: Concepts of Welding   **6 Hrs**

Introduction to welding - classification of welding and allied process - importance and applications of welding - welding symbols, types of joints and position of welding - types of electrode - selection of electrodes.

Chapter 1.2: Arc Welding Process   6 Hrs

Arc and resistance welding - arc welding power sources - DC power sources - DC generators - AC, DC rectifiers - AC power sources - generators and transformers - resistance welding - spot welding

Chapter 1.3: Gas Welding Process   6 Hrs

Gas welding - oxy-acetylene welding - gas welding techniques - manipulation and weaving methods - gas welding equipment - gas cutting - brazing - soldering - welding safety - safety recommendations for installation and operation of arc welding and cutting equipments - gas welding and cutting equipments.

UNIT - II
SPECIAL WELDING PROCESSES
Chapter 2.1: Special Welding Processes   9 Hrs

TIG welding - MIG welding - submerged arc welding - electro slag welding - plasma arc welding - metal spraying - principle of operation, equipment - merits and demerits - applications

Chapter 2.2: Advanced Welding Processes   9 Hrs

Ultrasonic welding - explosive welding - frictional welding - electron beam welding - laser beam welding - thermit welding - under water welding - concept - definition - principle of operation - equipment setup - merits and demerits - applications

UNIT - III
AUTOMATON AND INNOVATION OF WELDING
Chapter 3.1: Automation of Processes   9 Hrs

Welding sequence and classification of process - semi automatic - automatic welding - automated welding - automatic welding vs automated welding - remote welding - robotic welding.

Chapter 3.2: Innovation of Welding   9 Hrs

Introduction of innovation of welding - welding in wind - welding in low ambient temperature - welding in space - narrow gap welding - gravity welding - welding of plastics - welding of ceramics.

UNIT - IV
FERROUS AND NON-FERROUS METAL WELDING
Chapter 4.1: Ferrous Metal Welding   9 Hrs

Concept of weldability - welding processes for welding wrought iron - welding of cast iron - welding of low carbon steels, high carbon steels - welding of steel castings - welding of alloy steels - welding of stainless steels

Chapter 4.2: Non-Ferrous Metal Welding   9 Hrs

Welding of aluminum and its alloys - copper and its alloys - magnesium and its alloys - welding of dissimilar metals - thermal effects of welding - heat affected zones - grain size control - corrosion of welds - weld decay - dilution.

UNIT- V
WELDING ECONOMY, APPLICATIONS AND TESTING
Chapter 5.1: Welding Design and Defects   8 Hrs

Principles of sound welding design - economics of welding design - cost of welding design - cost of welding by different processes and selection of welding processes - principles governing design of good welding jigs and fixtures. Defects in welds - causes and remedies - welding distortion - control of welding distortion.

Chapter 5.2: Applications and Testing of Welding   9 Hrs

Testing of welds - stages of weld inspection and testing - inspection before welding, during welding and after welding - visual inspection - destructive testing of weld - hardness test, tensile test, bend test, impact test, nick break test, leak test - Non-destructive test, Liquid penetrant, Magnetic particle, Radiography and Ultrasonic inspection - quality control of welding.

Reference Books:

1. Welding Processes and Technology, Dr.R.S.Parmar - Khanna Publishers.
2. AWS Welding handbook, Vol I & Vol II.
3. Welding Technology, Richard L.Little, Tata McGraw Hill Publishing Co.
4. Advanced Welding Technology, Som Ashutosh, Acme Learning Pvt Ltd.

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6263.3 ELECTIVE THEORY - II: REFRIGERATION AND AIR-CONDITIONING
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6263.3 ELECTIVE THEORY - II: REFRIGERATION AND AIR-CONDITIONING	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	3 Hrs
			25	100	100	

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

UNIT - I
REFRIGERATION SYSTEM AND REFRIGERATION EQUIPMENTS
Chapter 1.1: Refrigeration System   **9 Hrs**
Thermodynamic state of a pure substances - modes of heat transfer - laws of heat transfer - mechanisms of production of cold - unit of refrigeration - types of refrigeration - reversed Carnot cycle - COP of heat engine - heat pump - refrigerating machine - principle of working of open and closed air system of refrigeration - Advantages and disadvantages - problems.

Chapter 1.2: Refrigeration Equipments   **9 Hrs**
Compressor - principle of working and constructional details of reciprocating and rotary compressors, hermetically and semihermetically sealed compressors - condensers - principle of working and constructional details of air cooled and water cooled condensers, evaporative condensers - advantages and disadvantages - natural and forced draught cooling towers. Evaporators - natural circulation and forced circulation type - principle of working constructional details.

UNIT - II
VAPOUR COMPRESSION REFRIGERATION SYSTEM AND VAPOUR ABSORPTION REFRIGERATION SYSTEM
Chapter 2.1: Vapour Compression Refrigeration System   **9 Hrs**
Principle of working of vapour compression system - analysis of vapour compression cycle using T-s diagram and p-H diagram- refrigerating effect - compression work - COP - effect of superheating and under cooling - problems - effect of evaporative pressure - condenser pressure - liquid - vapour refrigeration heat exchangers - advantages and disadvantages of superheating and undercooling - use of flash chamber and accumulator.

Chapter 2.2: Vapour Absorption Refrigeration System   **9 Hrs**
Simple absorption system - electrolux system - solar absorption system - absorption system comparison with mechanical (compression) refrigeration system.

UNIT - III
REFRIGERANT FLOW CONTROLS, REFRIGERANTS AND LUBRICANTS AND APPLICATION OF REFRIGERATION
Chapter 3.1: Refrigerant Flow Controls   **6 Hrs**
Capillary tube - automatic expansion valve - thermostatic expansion valve - solenoid valve - evaporator pressure regulator - suction pressure regulator -

Chapter 3.2: Refrigerants and Lubricants   **6 Hrs**
selection of a refrigerant - properties and applications of following refrigerants SO_2, CH_4, F11, F12, F22, and NH_3 - lubricants used in refrigeration and their applications, Cryogenics.

Chapter 3.3: Applications of Refrigeration   **6 Hrs**

Slow freezing - quick freezing - cold storage - frozen storage freeze drying - dairy refrigeration - ice cream cabinets - ice making - water cooler, milk cooler, bottle cooler - frost free refrigeration.

UNIT - IV
PSYCHOMETRIC AND COMFORT AIR CONDITIONING
Chapter 4.1: Psychometric   9 Hrs
Definitions of dry air, moist air, water vapour, Avogadro's law, Dalton's law of partial pressure - dry and wet bulb temperature - dew point - humidity - specific and absolute - relative humidity - degree of saturation - enthalpy of moist air - adiabatic saturation of air by evaporation of water - psychometric chart and its uses - psychometric processes.
Chapter 4.2: Comfort Air Conditioning   9 Hrs
sensible heating and cooling - humidifying and heating - dehumidifying and cooling - adiabatic cooling with humidification - total heating or cooling processes - sensible heat factor - by pass factor with simple problems - Governing optimum effective temperature - comfort chart - design consideration.

UNIT - V
AIR CONDITIONING SYSTEMS AND COOLING LOAD CALCULATIONS
Chapter 5.1: Air conditioning systems   8 Hrs
Equipment for air conditioning and insulation factors - air purification - temperature control - humidity control - dry and wet filters - centrifugal dust collector - air washer humidifier - dehumidifier - fans and blowers - grills and registers - summer and winter air conditioning, window type air conditioner - split type air conditioner system - properties of ideal insulator, types of insulating materials - air distribution and duct systems - tools and Installation, servicing and maintenance of R & AC systems.
Chapter 5.2: Cooling Load Calculations   9 Hrs
Different heat sources - conduction heat load - radiation - Load of sun - occupants load - equipment load - infiltration air load - miscellaneous heat sources - fresh air load - simple problems.

Reference books:
1. Refrigeration and air conditioning, P.L. Ballaney, Khanna Publishers, New Delhi 110 006.
2. Refrigeration and air conditioning, V.K. Jain,
3. Industrial Refrigeration Hand Book, Wilbert F. Steocker
4. A course in refrigeration and air conditioning, Domkundwar,

* Pattern of End Semester Exam Question Paper - General Pattern (Theory)

6264 - SOLID MODELLING PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	Hrs / Sem	Marks			Duration
6264 SOLID MODELLING PRACTICAL			Internal Assessment	External Exam*	Total	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

 * Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS
Introduction:
Parametric CAD software - sketch - elements - entities: line - circle - arc - ellipse - polygon - text - dimensions - sketch tools - fillet - chamfer - offset - trim - extend - mirror - rotate - block.
Part modeling - reference planes - reference point - reference axes - co-ordinate system - extrude - revolve - swept - helix and spiral - lofts - dome - shell - draft - rib - wrap - intersect - holes - patterns.

Assembly - approaches - mate - coincident - sub assembly - rebuild - isolate. Drawing views - save - plot - model view - exploded view - projected view - section view - import - export - Appearance - rendering.

EXERCISES:

PART A: Draw the given 3D drawing using 3D modelling commands.   **48 Hrs**
1. Model 1
2. Model 2
3. Model 3
4. Model 4
5. Model 5
6. Model 6

PART B: Draw the part models and assemble the components using 3D modelling.

48 Hrs

1. Revolving Centre
2. Tail Stock
3. Machine Vice
4. Crane Hook
5. Petrol Engine Connecting Rod
6. Pipe Vice

AUTONOMOUS EXAMINATION

Note: All the exercises should be completed and all the exercises should be given for examination. The students are permitted to select the question paper by lot or as per the allocation. Record notebook should be submitted during the practical examination.

Two exercises will be given for examination by selecting one exercise in each PART. The printout of exercises of the student work should be submitted with answer paper and the same have to be evaluated as per the allocation.

Detailed Allocation of Marks:

Sl. No.	Performance Indicator	Marks
Part A - 3D Component Modelling		
1	Sketching	15
2	3D Modelling	15
Part B - Assemble Drawing Modelling		
3	Sketching / Part modelling	20
4	Assembly	30
5	Solid Model / Views	10
6	Viva voce	10
Total		**100**

Exercises

PART A: Draw the given 3D drawing using 3D modelling commands.

91
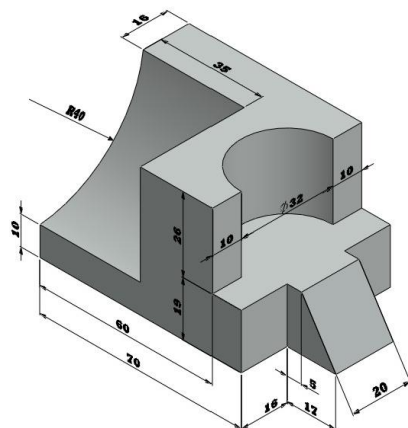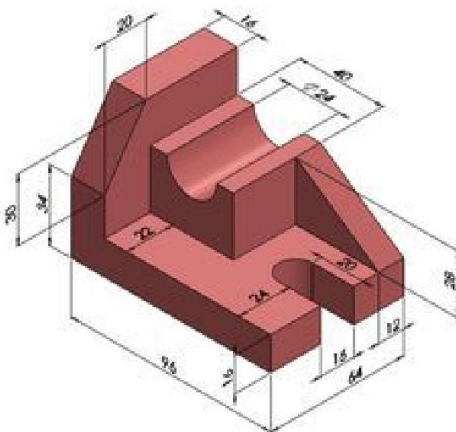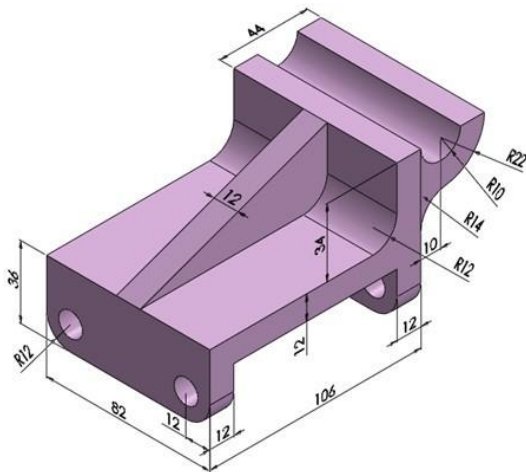
Model 1   Model 2
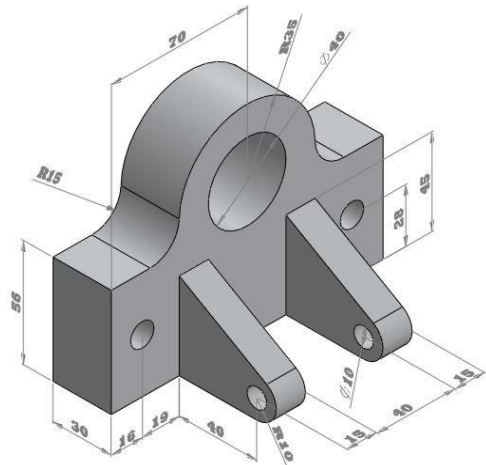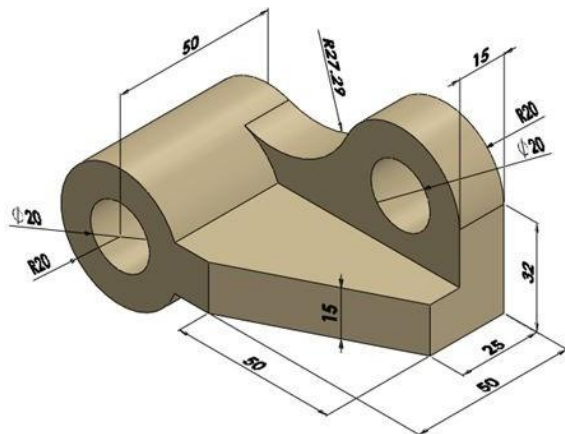

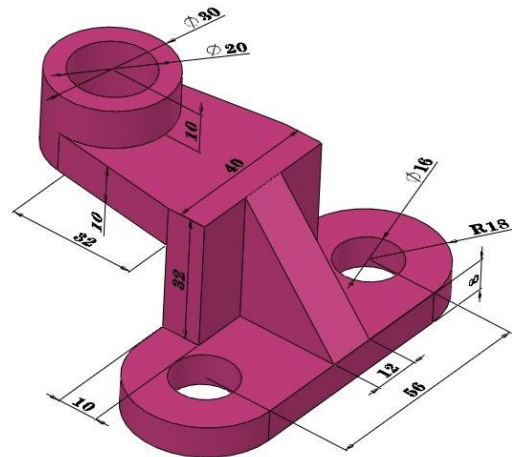Model 3   Model 4

Model 5   Model 6

6265.1   ELECTIVE PRACTICAL - II:
COMPUTER INTEGRATED MANUFACTURING PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6265.1 ELECTIVE PRACTICAL - II: COMPUTER INTEGRATED MANUFACTURING PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

DETAILED SYLLABUS

PART A: SOLID MODELLING   **48 Hrs**

Introduction to part modelling - datum plane - constraint - sketch - dimensioning - extrude - revolve - sweep - blend - protrusion - extrusion - rib - shell - hole - round - chamfer - copy - mirror - assembly - align - orient - drawing and detailing creating assembly views
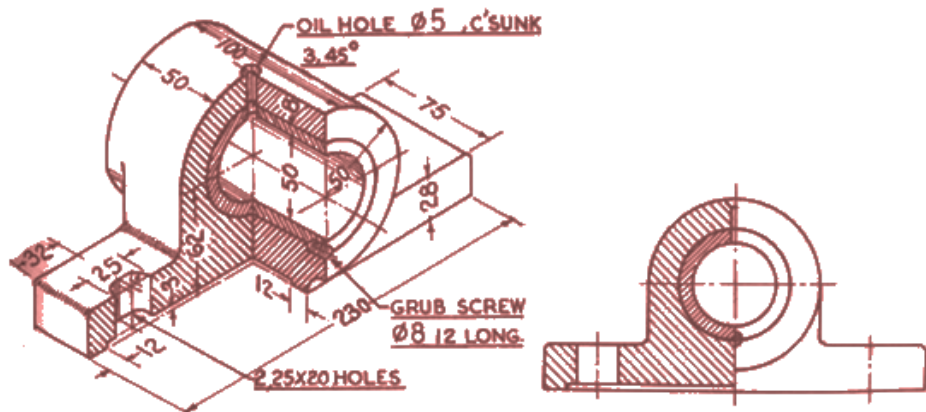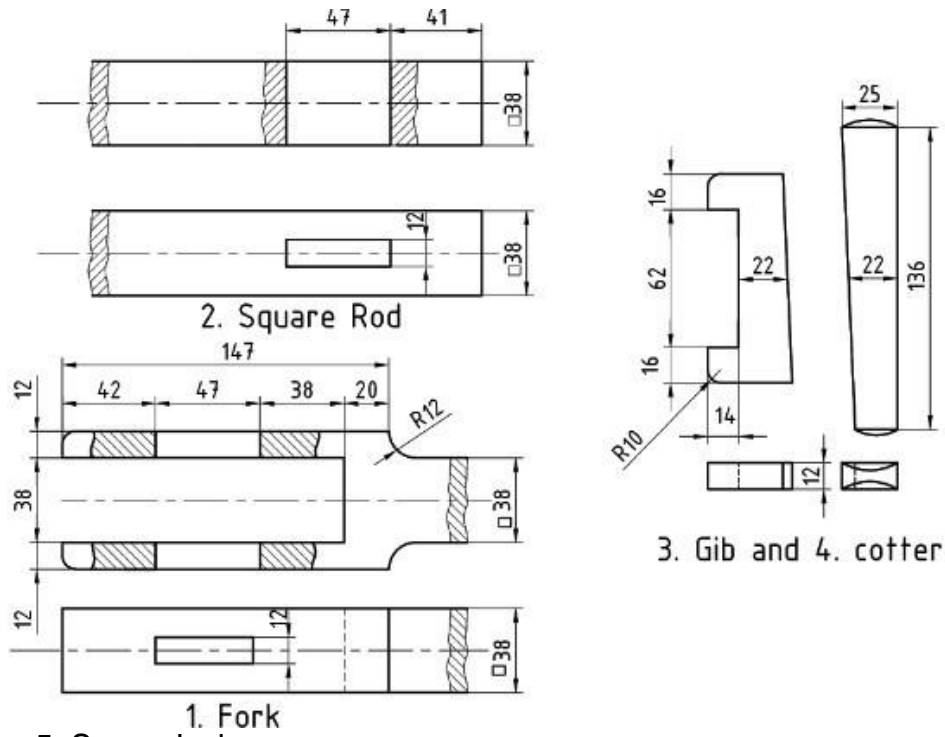
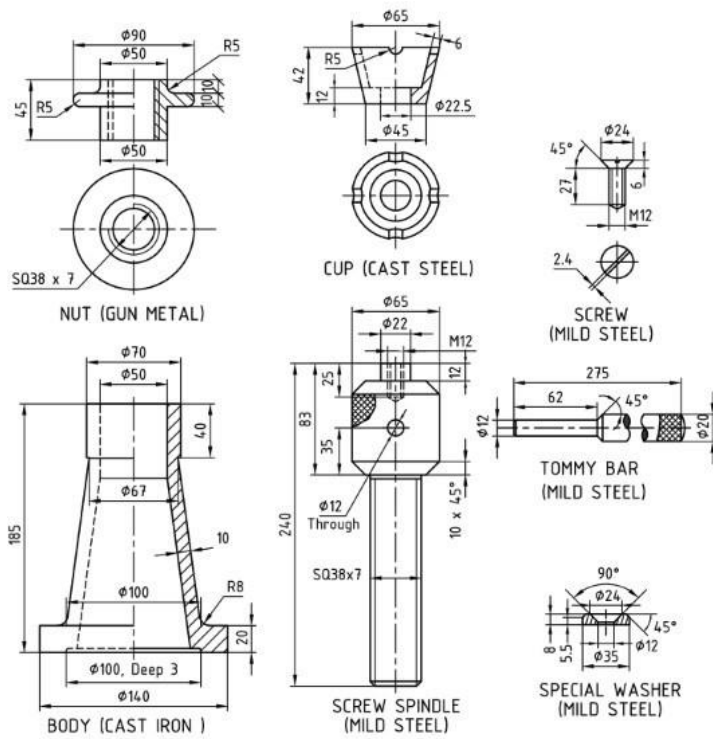Exercise No. 1. Geneva Wheel
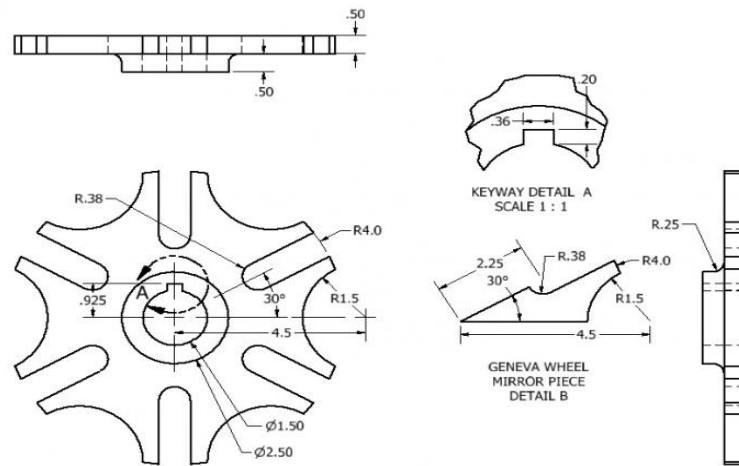
Exercise No. 2. Bearing Block
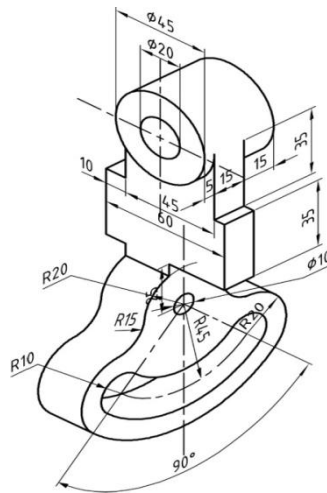
Exercise No. 3. Bushed bearing

Exercise No. 4. Gib and Cotter joint

2. Square Rod

3. Gib and 4. cotter

1. Fork

Exercise No. 5. Screw Jack

NUT (GUN METAL)

CUP (CAST STEEL)

SCREW (MILD STEEL)

BODY (CAST IRON)

SCREW SPINDLE (MILD STEEL)

TOMMY BAR (MILD STEEL)

SPECIAL WASHER (MILD STEEL)

Exercise No. 6. Universal Coupling

TAPER PIN–MS.2 OFF

CENTRE BLOCK,C.I–1 OFF

PIN&COLLAR,M.S–2OFF

FORK,C.I–2 OFF
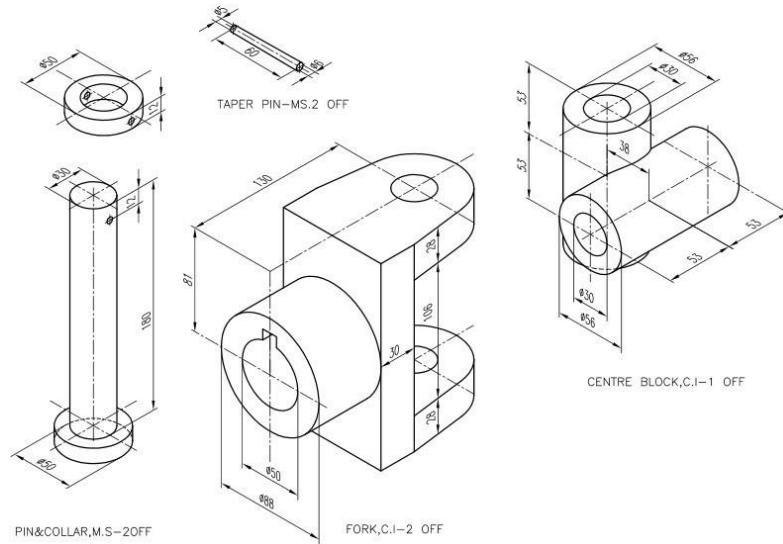
Note: Print the Assembled orthographic views and sectional views.

PART - B: CNC PROGRAMMING AND MACHINING   48 Hrs

1. Introduction, Study of CNC lathe and CNC milling.
2. Study of international standard codes: G-Codes and M-Codes
3. Format - Dimensioning methods.
4. Program writing - Turning simulator - Milling simulator, IS practice - Commands and Menus.
5. Editing the program in the CNC machines.
6. Set the machine and execute the program in the CNC machines.
Note: Create and edit the part program in the simulation software for verification of the part program. Enter / transfer the program to make the component in the CNC machine.
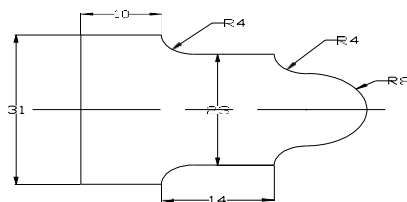
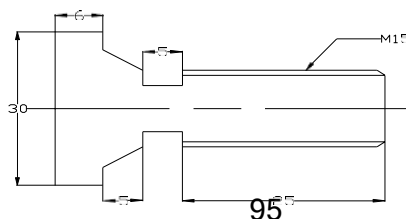## CNC TURNING MACHINE   Material: MS / Aluminium / Acrylic fibre / Plastic

1. Using linear and circular interpolation, create a part program and produce the component in the machine.
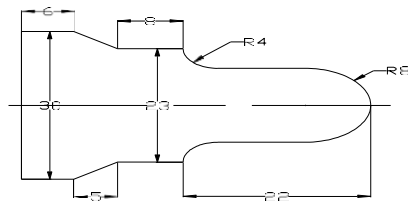
2. Using stock removal cycle create a part program for multiple turning operations and produce component in the machine.
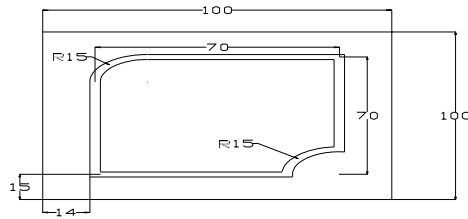

3. Using canned cycle create a part program for thread cutting, grooving and produce component in the machine.
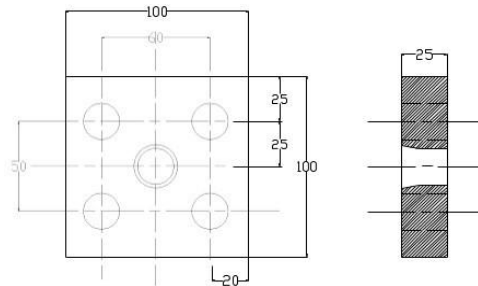

95

**CNC MILLING MACHINE** Material: MS / Aluminium / Acrylic fibre / Plastic

4. Using linear interpolation and circular interpolation create a part program for grooving and produce component in the machine.

5. Using canned cycle create a part program for drilling, tapping, counter sinking and produce component in the machine.

6. Using subprogram create a part program and produce component in the machine.
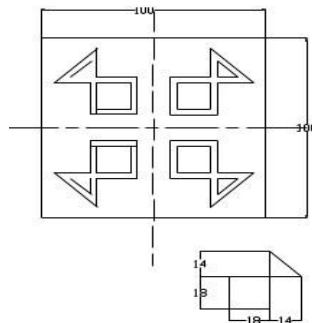
AUTONOMOUS EXAMINATION

Note: All the exercises should be completed and all the exercises should be given for examination. The students are permitted to select the question paper by lot or as per the allocation. Record notebook should be submitted during the practical examination.

Two exercises will be given for examination by selecting one exercise in each PART. The printout of exercises of the student work should be submitted with answer paper and the same have to be evaluated as per the allocation.

Part A: The given component drawing should be created and solid modeling after assembly should be printed and submitted along with the answer paper for evaluation.

Part B: The program for the given component should be written in the answer paper. The program should be entered in the CNC machine and the component should be submitted for evaluation. The machined component should be kept under the custody of examiner.

DETAILED ALLOCATION OF MARKS

Sl. No.	Performance Indicator	Marks
	PART A: Solid Modelling	
1	Creation of sketch	15
2	Modelling	25

3	Accuracy	05
PART B: CNC Programming		
4	Program	15
5	Setting	10
6	Editing and Machining	20
7	Viva-voce	10
Total		**100**

6265.2 ELECTIVE PRACTICAL - II: WELDING TECHNOLOGY PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6265.2 ELECTIVE PRACTICAL - II: WELDING TECHNOLOGY PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
			Internal Assessment	**External Exam***	**Total**	
	6 Hrs	96 Hrs	25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

EXERCISES:

PART - A   WELDING SIMULATION   **48 Hrs**
1. ARC WELDING
   a. Lap joint
   b. Butt Joint
   c. Corner Joint
   d. T - Joint

2 GAS WELDING
   a. Lap joint
   b. Butt Joint
   c. Corner Joint
   d. T - Joint

PART - B   EXERCISES   **48 Hrs**

1. TIG welding practice - Butt joint
2. MIG welding practice - Butt joint
3. Flash butt welding practice
4. Spot welding practice in thin sheets
5. Square tube welding (gas welding practice)
6. Pipe rolling welding (Arc welding)
7. Making butt and fillet joints by hand welding (with single - V) using arc welding
8. Butt welding of 25 x 3 mm flat - left ward, right ward using gas welding

AUTONOMOUS EXAMINATIONS

Note: All the exercises should be completed and all the exercises should be given for examination. The students are permitted to select the question paper by lot or as per the allocation. Two exercises will be given for examination by selecting one exercise in each PART. Record notebook should be submitted during the practical examination.

Allocation	Max. Marks
Simulation Practical (Part A - 2 questions) Arc and Gas welding (1 each)	30 Marks

Special Welding (Part B - 1 questions)	60 Marks
Viva-voce	10 Marks
Total	**100 Marks**

	Detailed Allocation	Max. Marks
	PART - A: SIMULATION	
1	Penetration	15
2	Finishing	15
	PART - B: SPECIAL WELDING	
1	Job Setting	20
2	Penetration	30
3	Finishing	10
4	Viva-voce	10
	Total	**100**

6265.3   ELECTIVE PRACTICAL - II: REFRIGERATION AND AIR-CONDITIONING PRACTICAL

Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
6265.3 ELECTIVE PRACTICAL - II: REFRIGERATION AND AIR-CONDITIONING PRACTICAL	**Hrs / Week**	**Hrs / Sem**	**Marks**			**Duration**
	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Experiments:
PART – A   **48 Hrs**
1. Determine the refrigerating effect, COP and the compressor capacity of a open type system with any one expansion device. (Thermostatic expansion valve / Capillary tube / Automatic Expansion Valve)
2. Determine the COP of sealed system by using electrical measurements.
3. Determine the capacity of a window air conditioner.
4. Determine the efficiency of a cooling tower.
5. Conduct Leak tests in a split air conditioning system, detect the failures and suggest the remedies. Conduct the Refrigerant Charge Test.
6. Conduct the flush test to remove the contaminants of refrigeration system and recharge.
PART- B   **48 Hrs**
1. Study the various sizes of copper and steel tubing. To study the various tools used for operations.
2. Study and carry out the various operations on copper and steel tubing- Flaring, Swaging and Soldering methods used in R & AC.
3. Study the methods to set and adjust the following a) Thermostats, b) Low pressure and high pressure cut-outs c) Thermostatic expansion valve d) Automatic Expansion Valve.
4. Conduct the service to change refrigerant into service cylinder from storage cylinder.
5. Conduct the service to pump down the system and to purge air from the system.
6. Conduct the service to check the oil level in the compressor and trace the common faults in R & AC units and their remedies.

AUTONOMOUS EXAMINATION

Note: All the exercises should be completed and all the exercises should be given for examination. The students are permitted to select the question paper by lot or as per the allocation. Two exercises will be given for examination by selecting one exercise in each PART. Record notebook should be submitted during the practical examination.

Detailed Allocation of Marks:

Sl. No.	Performance Indicator	Marks
PART - A		
1	Procedure	10
2	Formulae / Observation	20
3	Calculation / Result	20
PART - B		
4	Description / Procedure	15
5	Tool handling	15
6	Conclusion / Report	10
7	Viva voce	10
Total		**100**

6266 - PROJECT WORK AND INTERNSHIP
Teaching and Scheme of Examination

No. of weeks per semester: 16

SUBJECT	INSTRUCTION		EXAMINATION			
	Hrs / Week	**Hrs / Sem**	**Marks**			**Duration**
6266 PROJECT WORK AND INTERNSHIP	6 Hrs	96 Hrs	**Internal Assessment**	**External Exam***	**Total**	
			25	100	100	3 Hrs

* Examination will be conducted for 100 marks and the marks obtained will be converted into 75 marks.

Project Work and Internship:

The students of all the Diploma Courses have to do a Project Work as part of the Curriculum and in partial fulfillment for the award of Diploma by the State Board of Technical Education and Training, Tamil Nadu. The Project work must be reviewed twice in the same semester. The project work is approved during the V semester by the properly constituted committee with guidelines.

a) Internal assessment mark for Project Work and Internship:

Project Review - I	10 marks
Project Review - II	10 marks
Attendance	05 marks
Total	**25 marks**

Proper record should be maintained for the two Project Reviews and preserved for one semester after the publication of Exam results. It should be produced to the flying squad and the inspection team at the time of inspection/verification.

b) Allocation of Marks for Project Work and Internship

Demonstration / Presentation 25 marks
Project Report   25 marks
Viva-voce   30 marks
Internship Report   20 marks
Total   **100* marks**

*Examination will be conducted for 100 marks and will be converted to 75 marks.

c) Internship Report:

The internship training for a period of two weeks shall be undergone by every candidate at the end of IV / V semester during vacation. The certificate shall be produced along with the internship report for evaluation. The evaluation of internship training shall be done along with final year "Project Work & Internship" for 20 marks. The internship shall be undertaken in any industry / Government or Private certified agencies which are in social sector / Govt. Skill Centers / Institutions / Schemes.

A neatly prepared PROJECT REPORT as per the format has to be submitted by individual student during the Project Work and Internship Autonomous examination.