

NACHIMUTHU POLYTECHNIC COLLEGE

POLLACHI – 642 003

(Government Aided, Autonomous & Affiliated to State Board of
Technical Education & Training, Tamil Nadu)

Approved by AICTE, New Delhi and Accredited by APACC
(Asia Pacific Accreditation and Certification Commission),
Philippines with Gold Level



Diploma Programme
in
MECHANICAL ENGINEERING
(REFRIGERATION AND AIR-CONDITIONING)

SYLLABUS
(2021 Regulations)

For the batch of Students admitted from 2021– 2022

NACHIMUTHU POLYTECHNIC COLLEGE: POLLACHI
DEPARTMENT OF MECHANICAL ENGINEERING (R&AC)
VISION, MISSION AND PROGRAM EDUCATIONAL OBJECTIVES

VISION:

Develop dynamic, competent, industry-ready Diploma engineers in R&AC field and successful entrepreneurs.

MISSION:

- **M1:** Encourage faculty and staff to acuminate their technical knowledge and Skill continuously to make the teaching learning processes very effective in order to develop competent students.
- **M2:** Update the laboratory facilities and Sustain linkages with industries and alumni for the growth and development of students.
- **M3:** Cultivating a training program to ensure quality in design, installation and servicing.
- **M4:** Inculcate Ethical & Moral values, Interpersonal Skills, Leadership and Entrepreneurial qualities amongst students through curricular, co curricular & extracurricular intervention.

PROGRAM OUTCOMES (POs)

1. **Basic and Discipline specific knowledge:** Apply knowledge of basic mathematics, science and engineering fundamentals and engineering specialization to solve the engineering problems.
2. **Problem analysis:** Identify and analyse well-defined engineering problems using codified standard methods.
3. **Design/ development of solutions:** Design solutions for well-defined technical problems and assist with the design of systems components or processes to meet specified needs.
4. **Engineering Tools, Experimentation and Testing:** Apply modern engineering tools and appropriate technique to conduct standard tests and measurements.

5. **Engineering practices for society, sustainability and environment:** Apply appropriate technology in context of society, sustainability, environment and ethical practices.

6. **Project Management:** Use engineering management principles individually, as a team member or a leader to manage projects and effectively communicate about well-defined engineering activities.

7. **Life-long learning:** Ability to analyse individual needs and engage in updating in the context of technological changes.

PROGRAM EDUCATIONAL OBJECTIVES (PEO's)

- **PEO 1** – Educate Diploma engineers to serve in the field of design, installation and maintenance with technical competency and interpersonal skills to meet the industrial requirements.
- **PEO 2** – Motivate Diploma engineers in the execution of projects through innovative ideas.
- **PEO 3** –Develop diploma engineers with entrepreneurial skills and self-learning capabilities to excel in their profession.

PROGRAM SPECIFIC OUTCOME: (PSO's)

- **PSO1:** Design and develop products by applying recent technology to meet the industrial needs.
- **PSO2:** Apply the acquired technical and Professional knowledge for the sustainable growth and development of society.

NACHIMUTHU POLYTECHNIC COLLEGE POLLACHI – 642 003
(Autonomous & Affiliated to the State Board of Technical Education, Tamil Nadu)

REGULATIONS FOR DIPLOMA IN ENGINEERING
(REGULAR, SANDWICH AND PART TIME)

Note: The regulations hereunder are subject to amendments as may be made by the Academic Board of the Polytechnic College from time to time. Any or all such amendments will be effective from such date and to such batches of candidates including those already undergoing the programme as may be decided by the Academic Board.

1. Description of the Programme

1.1 Regular Diploma:

The Programme for the regular Diploma in Engineering shall be for duration of 3 years, consisting of 6 terms with 2 terms per year, normally the odd term spanning the period from June to November and the even term spanning the period from December to April of every academic year.

1.2 Sandwich:

The full time sandwich Diploma Programme in Mechanical Engineering shall be for duration of 3 ½ years consisting of 7 terms and the first year is common as all diploma programmes. During the 4th and 7th term, the students undergo industrial training for duration 6 Months. Examinations will be conducted after the completion of every 6 months industrial Training.

1.3 Part time:

The Part Time Diploma Programme in Mechanical Engineering and Electrical and Electronics Engineering shall be for duration of 4 years consisting of 8 terms and the courses in the first year is common to both the Part Time Diploma programmes.

1.4. Lateral Entry:

The HSc (vocational/academic) and 10+2 years ITI candidates are admitted into the third term of the 3 year Diploma in engineering and 3 ½ year sandwich Diploma Programme through lateral entry.

The minimum and maximum period for completion of Diploma Programmes are given below:

Diploma Programmes	Minimum Period	Maximum Period
Full Time	3 Years	6 Years
Full Time (Lateral Entry)	2 Years	5 Years
Sandwich	3½ Years	6½ Years
Sandwich (Lateral Entry)	2½ Years	5½ Years
Part Time	4 years	7 Years

Each term will have 16 weeks duration of study.

2. Eligibility for Admission

2.1 First year Diploma:

A pass in S.S.L.C Examination of the Board of Secondary Education, Tamil Nadu.

(or)

A pass in 10th Standard examination accepted by the Government of Tamil Nadu as equivalent thereto.

(or)

A pass in Anglo - Indian High School Examination with eligibility for Higher Secondary Course in Tamil Nadu.

(or)

A pass in matriculation examination conducted in Tamil Nadu.

(or)

A pass in any other examination recognized as equivalent to the S.S.L.C. examination, by the Board of Secondary Education, Tamil Nadu.

2.2 Second year Diploma:

A pass in HSc (vocational/academic), 10+2 years ITI with engineering subjects or an examination accepted by the Government of Tamil Nadu as equivalent thereto are eligible to get admitted into the second year, third term.

In addition, at the time of admission the candidates will have to satisfy certain minimum requirements, which may be prescribed from time to time, with regard to the marks, in the qualifying examinations.

3. Course exemption

Details of Course and credit exemption for the candidates with the entry qualification are given below

Entry Qualification	Entry level	Courses exempted	Credits transferred	Min Credits to be earned
10 th Standard	First Year	None	Nil	150
10 th Standard + Two years ITI	Second Year	All first year courses are exempted	57	93
HSc (Academic and Vocational)	Second Year		57	93

4. Course of study and curriculum outline

The course of study shall be in accordance with the syllabus prescribed from time to time, both in theory and practical. The curriculum outline for I term & II term is given in the syllabus book.

5. Programme of Study

The candidates have to opt for any one of the following branches of study under Multi Point Entry and Credit System (MPEC).

Branch No.	Diploma Programmes
01	Civil Engineering
02	Mechanical Engineering
03	Electrical and Electronics Engineering
04	Electronics and Communication Engineering
05	Textile Technology
06	Automobile Engineering
07	Mechanical Engineering (R & AC)
08	Computer Engineering
09	Printing Technology
10	Mechatronics
11	Communication and computer networking
12	Mechanical Engineering (Sandwich)
13	Mechanical Engineering (Part Time)
14	Electrical and Electronics Engineering(Part Time)

Note: Under MPEC system

Programme means Branch of study

Term means Semester

Course means Subject

6. Curriculum

6.1 The curriculum comprises courses as given in regulation in accordance with the prescribed syllabus. Candidates will also be required to undergo internship of minimum 4 weeks from III to V term vacation to qualify for the award of Diploma. The internship will be evaluated for 20 marks along with end term examination of project work. The end term project work & internship will be evaluated for 75 marks.

Internship is not required for sandwich and part time Diploma students.

6.2 Each course is assigned a weightage in terms of credits. The number of credit for each course is determined as given below:

For one period of theory	1 Credit
For two periods of laboratory/Tutorial/ Project Work	1 Credit
For three periods of drawing	2 Credits

6.3 Extra Credit Courses

In addition to the prescribed curriculum, each student is required to register for a minimum of two extra credit courses offered by the respective departments during fourth and fifth term. This extra credit courses are not required for part time Diploma students.

No final examination will be conducted for these extra credit courses. The performance of the student will be evaluated continuously through quizzes / seminars / tests. Based on the performance of the student they will be awarded grades as good, satisfactory or needs improvement.

7. Requirement of attendance and progress

The examinations will be conducted at the end of each term for all the programmes by the institution under Autonomous Scheme. A candidate will be permitted to appear for the Autonomous Examination only if he / she secures a minimum of 80% overall attendance in the term concerned.

8. Condonation of Attendance

Under extraordinary circumstances, if there exists genuine and valid reasons the Principal of the college has been empowered for one time condonation over the period of study up to a maximum of 5% shortage to a candidate, subject to the condition that he / she satisfies all the other requirements to appear for the Autonomous Examination. It shall not be claimed as a matter of right by all the candidates. Under no circumstances a candidate with overall attendance less than 75% is permitted to write the Autonomous Examination.

9. Eligibility to appear for End Term Examination

The candidate is required to have a minimum of 80% overall attendance. Otherwise he / she is not eligible to appear for the end term examination.

- 9.1 A student who had failed to acquire the minimum requirement of 80% overall attendance for the term of study or discontinued his / her studies in the middle of a term or who had not paid the examination fee in time shall not be permitted to appear for the Autonomous Examination.
- 9.2. A regular student who had failed to register himself / herself for the Autonomous Examination by paying the examination fee within the prescribed time limit shall not be permitted to continue his / her studies in the term after the due date is over.
- 9.3. A student who had paid the examination fee in time, but do not have the minimum required attendance for that term of study, shall not be permitted to appear for the Autonomous Examination even if he / she receives the hall ticket. Such candidate will be permitted to write the supplementary examinations of previous term if any, using the same hall ticket.
- 9.4. A student who had been debarred from appearing for the Autonomous Examination for involvement in any malpractice in the previous examination shall not be permitted to attend the class or pay the fee or appear for the examinations till the punishment period is over.
- 9.5. A student who had exhausted the maximum permitted time limit of 5/5½/6/6½/7 years respectively from the date of joining the programme for Lateral entry/Lateral Entry Sandwich/Regular/Sandwich and Part time shall not be permitted to pay the fee or appear for the examination, unless otherwise notified.
- 9.6. A regular student who had been expelled and issued TC from the institution on disciplinary measures shall not be permitted to register / appear for the Autonomous Examinations.
- 9.7. A student could not claim eligibility to appear for the examination on the ground that he / she had received the hall ticket from the institution by paying the examination fee, normally one month prior to the commencement of the examinations. The Principal will issue the hall tickets to the candidate if he / she satisfies all the conditions.

10. Eligibility for Readmission

A student who had discontinued his / her studies in the middle of a term or who had not appeared for Autonomous Examination of current term of study can apply and get readmission in the same term in the subsequent or following academic years if he / she desire to complete the programme and satisfies the following conditions:

- 10.1 The candidate should not have exhausted the total period of study permitted from the year of admission in first year to complete the course.
- 10.2 A student on readmission should be able to complete his / her full course of study within the stipulated total period. A candidate who had discontinued his / her studies continuously or in spells for more than 3 years shall not be recommended for readmission.
- 10.3 A candidate who had been expelled from one institution, for any reason, shall not be given admission.
- 10.4 A candidate, who had been debarred from writing Autonomous Examination for his / her involvement in any malpractice, shall not be allowed to continue his / her studies. The institution shall not issue Transfer Certificate or Course completion Certificate to such candidate till the period of punishment is over.
- 10.5 A candidate, whose petition is pending in any court with respect to his / her admission/ exam results / punishment etc. and who had discontinued the studies shall not be readmitted in the institution without getting the prior permission of the Chairman, Board of Studies and Examinations / The Chairman Awards Committee.
- 10.6 Readmission is not permissible in First term regular and Part Time students and in third term for lateral entry students who have not written any Autonomous Examinations before their discontinuance of study. They have to forego their candidature and seek admission afresh.

Usually 15 days before the day of re-opening of institution for the term, a last date, is being fixed and announced for the readmission of students. The Principal can himself readmit the candidates who apply for readmission on or before the prescribed due date in the term / year in which they had discontinued, if they satisfy all the conditions specified above and submit the proposal to the office of the Chairman, Board of Examinations in the standard format with necessary documents for approval and ratification. The Principal may permit such readmitted student to attend the classes, without waiting for the receipt of approval orders from the Chairman's office, after obtaining an undertaking from the candidates to the effect that they will abide to the decision of the Chairman, Board of Examinations.

11. Eligibility to continue in the next higher term / year

- 11.1 A student with enough attendance in a particular term / year and who had registered himself / herself for the Autonomous Examination by paying the fee on time and received the hall ticket has to necessarily appear for the Autonomous Examination in at least one course (Either Theory or Practical) of the concerned regular term / year (not in supplementary course of previous term / year) in which he / she is studying to become eligible to continue his / her studies in the next term / year, in the Institution.
- 11.2 A regular candidate who had received the hall ticket but not appeared for the Autonomous Examination at least in a single course (Theory or Practical) of the current term / year of study shall not be permitted either to continue his / her studies in the next term / year or to appear for the courses as supplementary in the subsequent examinations. He/ she will be considered as a discontinued candidate. Such candidate has to be re-admitted in the same term / year in the next academic year and satisfy all the prescribed requirements with respect to attendance, payment of fees etc. to become eligible to write the Autonomous Examinations. In any case, a candidate will not be permitted to appear afresh for the examinations of two terms / years in the same sitting.
- 11.3 A regular candidate who had received the Hall Ticket from the Chairman, Awards Committee satisfying the requirements of attendance but not appeared for the Autonomous Examinations at least in a single paper (Theory or Practical) of the current term / year of study due to the reasons that:-

- a) The candidate has been hospitalized and could not physically move out due to medical reasons and produces a certificate to this effect from the Medical Board of a Government Hospital at Headquarters;
- b) Natural cause such as floods, Tsunami and produces a certificate to this effect from the Tahsildar of the respective Taluk shall be permitted to continue his / her studies in the next term / year.

This shall be permitted only once during the programme of study.

12. Examinations

Autonomous examinations in all courses of the term under the scheme of examination will be conducted at the end of each term. The internal assessment marks for all the courses will be awarded on the basis of continuous assessment earned during the term concerned. For each course, 25 Marks are allotted for internal assessment and 75 Marks are allotted for End term Examination.

13. Continuous Internal Assessment

Internal assessment marks are given for a maximum of 25 marks. Total marks obtained by the candidate for 100 marks are converted to 25 marks.

The present system of assessment of internal marks shall be as follows

Allocation of marks

1) Attendance:

10 marks is awarded for Attendance. Marks allotted for attendance to the candidate for each theory, practical, drawing and project work courses are as given below

80-89%	attendance	:	9 marks
90-100%	attendance	:	10marks

2) Theory courses

Theory courses there shall be 3 Continuous Assessment Tests conducted for 75 Marks and converted into 60 Marks. The internal assessment marks will be awarded based on the average of best of first two CATs and 3rd CAT.

TEST	SYLLABUS	MAXIMUM MARKS	DURATION	WHEN TO CONDUCT
CAT 1	I & II Unit	75	3 Hrs.	30 working days from Reopening
CAT 2	I, II, III & IV Unit	75	3 Hrs.	30 working days from CAT 1
CAT 3	All Units	75	3 Hrs.	After last working day

There shall be 4 Class & 4 Home assignments. Internal marks will be awarded based on the average of best 3 class assignments & 3 home assignments out of 20 marks and 10 marks respectively.

S. No	Description	Max. Marks
1	Continuous Assessment Test (CAT)	60
2	Class Assignment	20
3	Home Assignment	10
4	Attendance	10
	Total	100

3) Practical courses

S. No	Description	Max. Marks
1	Observation	40
2	Record	20
3	Model Exam	30
4	Attendance	10
	Total	100

For Practical Courses after completion of each exercise, record should be submitted in the subsequent Practical classes and marks awarded for observation should be carried over to record.

The mark for Observation should be awarded for 40 marks in each experiment and the mark for Record should be awarded for 20 marks in each experiment.

The students have to submit the duly signed Bonafide record note book / file during the End Practical Examinations.

All the experiments indicated in the syllabus should be completed and the same be given for final End Examinations.

4) Drawing

S.No	Description	Max. Marks
1	Continuous Assessment Test (CAT)	60
2	Assignment	30
3	Attendance	10
	Total	100

5) Project work & Internship

S.No	Description	Max. Marks
1	Periodic report performance (not less than 3 reviews)	20
2	Report preparation	20
3.	Model Examination i. Internship review – 20 Marks ii. Demonstration and viva-voce – 30 Marks	50
4.	Attendance	10
	Total	100

In the case of Project work and Internship, candidates will be permitted to appear for the final examination, only if he/she has submitted the project work report and internship report within the prescribed time.

A Candidate who fails to submit the project work report and internship report within the prescribed time or whose report is not accepted for reasons of incompleteness or other serious deficiencies will have to register and redo and submit the reports at the end of the subsequent term following the final term.

End term Examinations will normally be conducted in October / November for Odd term and in April / May of Even term in each year.

A candidate will be permitted to appear for the final examination of the term only if he/she secures 80 % overall attendance in the program of the term concerned. A candidate will be permitted to register for the VI term, if he/she successfully completed 4 Weeks of internship from III to V term vacations except sandwich and part time students. A candidate will not be permitted to register for final examination unless he/she simultaneously registers for the examination of current term eligible and supplementary if any in the lower terms.

14. Revaluation

A candidate can apply for revaluation of his/her answer script of any theory paper he/she had appeared. First, the candidate has to fill in the prescribed application form and remit necessary fee (Rs.250/- per paper) for getting the Photo copy of answer script. After going through the photo copy of the answer script, if the candidate desires for revaluation of his/ her answer script, he/she has to fill in the application form enclosed with the Photo copy and pay the revaluation fee of Rs.500/- per paper.

The candidate who secure higher marks in the revaluation have to surrender their original mark sheet to get the revised mark sheet. A candidate, who had applied for the Photo copy of the answer book only, can apply for revaluation of the same. The revaluation system is not applicable to the practical / project work and supplementary courses.

15. Criteria for pass

15.1 A candidate shall be declared to have passed the examination in a course if he/she secures not less than 40% in theory course and 50% in practical course and project work out of the total prescribed maximum marks including both the internal and the external examination marks put together as stated below.

Name of the examination	Maximum Marks	Minimum marks required for pass in the external examinations (out of 75)	Minimum marks to pass (both internal & external examinations put together) (out of 100)
Theory	100	30	40
Drawing	100	30	40
Practical/ project work	100	38	50

15.2. No candidate shall be eligible for the award of Diploma unless he/ she has undergone the prescribed programme of study successfully and pass all the courses prescribed in the Curriculum

16. Eligibility for the Award of Diploma

No candidates shall be eligible for the Diploma unless he/she has undergone the prescribed course of study for a period of not less than 3 academic years in an institution when joined in the first year, and two years, if joined under lateral entry scheme in the second year, affiliated to the State Board of Technical Education and Training, Tamil Nadu and has passed the prescribed examination.

17. Classification of successful candidates

17.1 First Class with Superlative Distinction:

A candidate will be declared to have passed in **First Class with Superlative Distinction** if he / she secures not less than 75% of the marks in all the courses from first term/ third term for lateral entry and passes all the terms in the first appearance itself and passes all the courses within the stipulated period of study 3 years for Full Time, 3½ years for Sandwich, 4 years for Part Time and 2 years for lateral entry without any break in study.

17.2 First Class with Distinction:

A candidate will be declared to have passed in **First Class with Distinction** if he / she secures more than 75% of the aggregate marks in all the terms put together except I and II term and passes all the above term in the first appearance itself and completes all the courses including that of I and II terms within the stipulated period of study (Three Years for regular, Two Years for Lateral Entry and Four Years for Part Time) without any break.

17.3 First Class:

A candidate will be declared to have passed in **First Class** if he / she secures not less than 60% of the aggregate marks in all the terms put together except I and II term and completes all the courses including that of I and II terms within the stipulated period of study (Three Years for regular, Two Years for Lateral Entry and Four Years for Part Time) without any break.

17.4 Second Class:

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

18. Duration of a period in the Class Time Table:

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

1. FOUNDATION COURSES:

COURSE CODE	COURSE NAME	CREDIT
0101	Communicative English – I	5
0102	Engineering Mathematics – I	6
0103	Engineering Physics – I	5
0104	Engineering Chemistry – I	5
0106	Workshop Practice	1.5
0107	Engineering Physics - I Practical	1
0108	Engineering Chemistry - I Practical	1
0111	Communicative English – II	5
0113	Engineering Physics – II	5
0114	Engineering Chemistry – II	5
0117	Engineering Physics - II Practical	1
0118	Engineering Chemistry - II Practical	1
Total		41.5

2. CORE COURSES:

COURSE CODE	COURSE NAME	CREDIT
2203	Manufacturing Processes *	5
2204	Electrical and Electronics Engineering*	5
2207	Machining Processes*	5
9201	Strength of Materials and Fluid Mechanics	5
9202	Thermal Engineering	5

9203	Strength of Materials and Fluid Mechanics Practical	2
9204	Thermal Engineering Practical	2
9205	Manufacturing Technology Practical	2
9206	Electrical and Electronics Engineering Practical	2
9207	Machine Drawing Practical	2.5
0212	Engineering Mathematics – II	6
0205	Engineering Drawing - I	4
0215	Engineering Drawing - II	4
0206	Communication Skill Practical	1.5
Total		51

3. APPLIED COURSES:

COURSE CODE	COURSE NAME	CREDIT
2310	Entrepreneurship and Startups *	2
9301	R&AC Machines	5
9302	R&AC Machines Practical	2
9303	Heat Transfer	5
9304	Heat Transfer Practical	2
9305	Refrigeration	6
9306	Air-Conditioning	5
9307	Refrigeration Practical	2
9308	Air-Conditioning Practical	2

9309	Installation, Servicing and Applications of R & AC	6
9310	Food Processing, Preservation and Transport Air-Conditioning	5
9311	HVAC Drawing and CAD practical	2.5
9312	Project work and Internship	3
Total		47.5

4. DIVERSIFIED COURSES:

S.No	Theory / Practical	Code No.	Course Name	CREDIT
1	Theory	9401A	Computer Aided Design and Manufacturing	5
2		9401 B	Mechatronics*	5
3		9401 C	Automobile technology*	5
4	Theory	9403 A	Design of R&AC Systems	5
5		9403 B	Cryogenic Engineering	5
6		9403 C	Green Energy and Energy Conservation	5
4	Practical	9402 A	CAD/CAM Practical	2
5		9402 B	Mechatronics Practical*	2
6		9402 C	Automobile technology Practical*	2
7	Practical	9404 A	Design of R&AC Systems Practical	2
8		9404 B	Cryogenic Engineering Practical	2
9		9404 C	Green Energy and Energy Conservation Practical	2

*Common with Mechanical Engineering

5. CREDIT ABSTRACT:

S. NO.	COURSE	CREDIT	PERCENTAGE
1	Foundation Courses	41.5	26.95
2	Core Courses	51	33.11
3	Applied Courses	47.5	30.84
4	Diversified Courses	14	9.10
Total		154	100.00

DEPARTMENT OF MECHANICAL ENGINEERING (R&AC)
CURRICULUM OUTLINE AND SCHEME OF EXAMINATION

III TERM

S.No.	Code No.	Course Name	Periods / Week					Credit	Scheme of Examination			Minimum marks for pass	Duration of Exam (Hrs)
			Lecture	Tutorial	Practical	Drawing	Total		Internal	External	Total		
1	9201	Strength of Materials and Fluid Mechanics	5	-	-	-	5	5	25	75	100	40	3
2	2203	Manufacturing Processes *	5	-	-	-	5	5	25	75	100	40	3
3	9202	Thermal Engineering	5	-	-	-	5	5	25	75	100	40	3
4	9301	R&AC Machines	5	-	-	-	5	5	25	75	100	40	3
5	9203	Strength of Materials and Fluid Mechanics Practical	-	-	4	-	4	2	25	75	100	50	3
6	9204	Thermal Engineering Practical	-	-	4	-	4	2	25	75	100	50	3
7	9302	R&AC Machines Practical	-	-	4	-	4	2	25	75	100	50	3
8	PS03	Professional Skills (Personal Effectiveness) [#]	1	-	-	-	1	-	-	-	-	-	-
9		Library	-	-	-	-	1	-	-	-	-	-	-
10		Physical Education	-	-	-	-	1	-	-	-	-	-	-
		Total	21	-	12	-	35	26	-	-	700	-	-

CURRICULUM OUTLINE AND SCHEME OF EXAMINATION

IV TERM

S.No.	Code No.	Course Name	Periods / Week					Credit	Scheme of Examination			Minimum marks for pass	Duration of Exam (Hrs)
			Lecture	Tutorial	Practical	Drawing	Total		Internal	External	Total		
1	2204	Electrical and Electronics Engineering*	5	-	-	-	5	5	25	75	100	40	3
2	2207	Machining Processes*	5	-	-	-	5	5	25	75	100	40	3
3	9303	Heat Transfer	5	-	-	-	5	5	25	75	100	40	3
4	9205	Manufacturing Technology Practical	-	-	4	-	4	2	25	75	100	50	3
5	9206	Electrical and Electronics Engineering Practical	-	-	4	-	4	2	25	75	100	50	3
6	9207	Machine Drawing Practical	-	-	5	-	5	2.5	25	75	100	50	3
7	9304	Heat Transfer Practical	-	-	4	-	4	2	25	75	100	50	3
8	PS04	Professional Skills (Ethical and Moral Responsibility) [#]	1	-	-	-	1	-	-	-	-	-	-
9		Library	-	-	-	-	1	-	-	-	-	-	-
10		Physical Education	-	-	-	-	1	-	-	-	-	-	-
		Total	16	-	17	-	35	23.5	-	-	700	-	-

CURRICULUM OUTLINE AND SCHEME OF EXAMINATION

V-TERM

S.No.	Code No.	Course Name	Periods / Week					Credit	Scheme of Examination			Minimum marks for pass	Duration of Exam (Hrs)
			Lecture	Tutorial	Practical	Drawing	Total		Internal	External	Total		
1	9305	Refrigeration	6	-	-	-	6	6	25	75	100	40	3
2	9306	Air-Conditioning	5	-	-	-	5	5	25	75	100	40	3
3	9401 A	Diversified Course- I	5	-	-	-	5	5	25	75	100	40	3
4	9307	Refrigeration Practical	-	-	4	-	4	2	25	75	100	50	3
5	9308	Air-Conditioning Practical	-	-	4	-	4	2	25	75	100	50	3
6	9402 A	Diversified Course Practical- I	-	-	4	-	4	2	25	75	100	50	3
7	2310	Entrepreneurship and Startups *	-	-	4	-	4	2	25	75	100	50	3
8	PS05	Professional Skills (Teamness , Inter-Personal Skills) #	1	-	-	-	1	-	-	-	-	-	-
9		Library	-	-	-	-	1	-	-	-	-	-	-
10		Physical Education	-	-	-	-	1	-	-	-	-	-	-
		Total	17	-	16	-	35	24	-	-	700	-	-

List of Diversified Courses

V TERM

S.No	Theory / Practical	Code No.	Course Name
1	Theory	9401A	Computer Aided Design and Manufacturing
2		9401 B	Mechatronics*
3		9401 C	Automobile technology*
4	Practical	9402A	CAD/CAM Practical
5		9402B	Mechatronics Practical*
6		9402C	Automobile technology Practical*

CURRICULUM OUTLINE AND SCHEME OF EXAMINATION

VI-TERM

S.No.	Code No.	Course Name	Periods / Week					Credit	Scheme of Examination			Minimum marks for pass	Duration of Exam (Hrs)
			Lecture	Tutorial	Practical	Drawing	Total		Internal	External	Total		
1	9309	Installation, Servicing and Applications of R & AC	6	-	-	-	6	6	25	75	100	40	3
2	9310	Food Processing, Preservation and Transport Air-Conditioning	5	-	-	-	5	5	25	75	100	40	3
3	9403 A	Diversified Course- II	5	-		-	5	5	25	75	100	40	3
4	9311	HVAC Drawing and CAD practical	-	-	5	-	5	2.5	25	75	100	50	3
5	9404 A	Diversified Course Practical- II	-	-	4	-	4	2	25	75	100	50	3
6	9312	Project work and Internship	-	-	6	-	6	3	25	75	100	50	3
7	PS06	Professional Skills (Campus to Corporate) [#]	1	-	-	-	1	-	-	-	-	-	-
8		Library	-	-	-	-	1	-	-	-	-	-	-
9		Physical Education	-	-	-	-	2	-	-	-	-	-	-
		Total	17	-	15	-	35	23.5	-	-	700	-	-

List of Diversified Courses

VI TERM

S.No	Theory / Practical	Code No.	Course Name
1	Theory	9403 A	Design of R&AC Systems
2		9403 B	Cryogenic Engineering
3		9403 C	Green Energy and Energy Conservation
4	Practical	9404 A	Design of R&AC Systems Practical
5		9404 B	Cryogenic Engineering Practical
6		9404 C	Green Energy and Energy Conservation Practical

*Common with Mechanical Engineering

Common to all programmes

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 on wards)**

Programme : Mechanical Engineering (R&AC)
Term : III
Course Code : 9201
Course Title : Strength of Materials and Fluid Mechanics
Number of Periods per week : 5
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9201	Strength of Materials and Fluid Mechanics	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Mechanical properties of materials, simple stresses and strains	14	0	0	14
2	Geometrical properties of sections and thin cylinders	14	0	0	14
3	Properties of fluids and pressure measurements	13	0	0	13
4	Flow of fluids and flow through pipes	13	0	0	13

5	Centrifugal and Reciprocating pumps	11	0	0	11
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Solve problems on various elastic constants(UNIT-1)
2. Calculate moment of inertia of various sections and changes in dimensions of thin cylinders(UNIT-2)
3. Solve problems on properties of fluid and pressure measurements(UNIT-3)
4. Verify Bernoulli's theorem (UNIT-4)
5. Determine the efficiency of Centrifugal and Reciprocating Pumps(UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	MECHANICAL PROPERTIES OF MATERIALS, SIMPLE STRESSES AND STRAINS	14	0	0
	1.1 Mechanical Properties of Materials: Introduction - Definition of Mechanical Properties such as strength - elasticity, plasticity, ductility, malleability, stiffness, toughness, brittleness, hardness, wear resistance, machinability, castability and weldability - fatigue strength, creep - temperature creep - cyclic loading and repeated loading - endurance limit.	6	0	0
	1.2 Simple stresses and strains: Introduction - definition - load, stress and strain - classification of force systems - tensile, compressive and shear force systems - Behavior of mild steel in tension upto rupture - stress - strain diagram - limit of proportionality - elastic limit - yield stress - breaking stress - ultimate stress - percentage of elongation and percentage reduction in area - Hooke's law - definition - Young's modulus, working stress, factor of safety,	8	0	0

	shear stress and shear strain, modulus of rigidity. Linear strain - deformation due to tension and compression and shear force. Definition - lateral strain - Poisson's ratio - volumetric strain - bulk modulus - volumetric strain of rectangular and circular bars - problems connecting, lateral and volumetric deformation - Elastic constants and their relationship (No derivation) - problems on elastic constants. Definition - composite bar - problem in composite bars subjected to tension and compression - Temperature stresses and strains - simple problems.			
2	GEOMETRICAL PROPERTIES OF SECTIONS AND THIN CYLINDERS	14	0	0
	2.1 Geometrical Properties of Sections: Introduction - center of gravity – centroid – position of centroids of plane geometrical figures such as rectangle, triangle, circle and trapezium (no derivation) – Simple problems to determine centroid of angles, I and T sections only (No problems on removed sections) – moment of inertia – Statement of parallel axes theorem and perpendicular axes theorem (No derivation) – Definition – Polar moment of inertia – radius of gyration – Simple problems in computing moment of inertia and radius of gyration for angle, T, and I sections (No problems on removed sections).	8	0	0
	2.2 Thin Cylinders : Introduction - Definition - Thin and Thick cylindrical shell - Failure of thin cylindrical shell subjected to internal pressure - Hoop and longitudinal stress causes in a thin cylindrical shell subjected to internal pressure (no derivation) - simple problems - change in dimensions of a thin cylindrical shell subjected to internal pressure – problems.	6	0	0

3	PROPERTIES OF FLUIDS AND PRESSURE MEASUREMENTS	13	0	0
	3.1 Properties of Fluids: Introduction - definition of fluid - classification of fluids - ideal and real fluids - properties of a fluid - definition and units- Pressure - units of pressure - pressure head - atmospheric, gauge and absolute pressure - problems - Pascal's law and its applications.	7	0	0
	3.2 Pressure Measurements: Pressure measurement - piezometer tube - simple U - tube manometer - Differential U - tube manometer - problems - precautions in using manometers - mechanical gauges - Bourdon's tube pressure gauge - diaphragm gauge- Pitot tube.	6	0	0
4	FLOW OF FLUIDS AND FLOW THROUGH PIPES	13	0	0
	4.1 Flow of Fluids: Types of fluid flow - path line and stream line - mean velocity of flow - discharge of a flowing fluid - equation of continuity of fluid flow - energies of fluid - Bernoulli's theorem - statement - assumptions and proof - applications and limitations of Bernoulli's theorem - Venturimeter - orifice meter - differences between Venturimeter and orifice meter – (No derivation) -Simple problems. Orifice - types - applications – Definitions of hydraulic coefficients - discharge through orifice- discharging freely (No derivation) – Simple problems – experimental method of finding C_v , C_c and C_d	9	0	0
	4.2 Flow Through Pipes: Flow through pipes - laws of fluid friction - hydraulic gradient line - total energy line - wetted perimeter - hydraulic mean radius - loss of head due to friction - Darcy - Weisbach equation and Chezy's formula (No derivation) - problems -	4	0	0

	minor losses (description) - power transmission through pipes (No derivation) – Simple problems.			
	CENTRIFUGAL AND RECIPROCATING PUMPS	11	0	0
5	5.1 Centrifugal Pumps: Centrifugal pumps - classifications - working of single stage - components (with types if any) multi stage pumps - advantages - priming - priming chamber - head of a pump - manometric, mechanical, overall efficiencies – cavitations- special pumps - deep well and jet pumps - -Simple problems.	6	0	0
	5.2 Reciprocating Pumps: Reciprocating pumps - classifications - working of single acting double acting reciprocating pumps - plunger and piston pumps - discharge of a reciprocating pump - theoretical power required - coefficient of discharge - slip - negative slip - indicator diagram - separation - Air vessels (Functions and Working)-Simple problems.	5	0	0

TEXT BOOKS:

1. R. K. Bansal, “Fluid Mechanic and Hydraulic Machines”, Laxmi Publications, 2010.
2. R. S. Khurmi,” Strength of Materials”, S.Chand& Co, 2019.

REFERENCE BOOKS:

1. R.K.Rajput,”Strength of materials,” S.Chand& Co,2018
2. R.C.HIBBELER,”Mechanics of Materials”, pearson publications,2011.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9201 - STRENGTH OF MATERIALS AND FLUID MECHANICS

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions (5x1= 5 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	Young's modulus for steel is a) 2×10^5 N/mm ² b) 0.8×10^5 N/mm ² 1.2 $\times 10^5$ N/mm ² d) 0.30×10^5 N/mm ²	1	1	R
2	Load which vary from minimum to maximum value of same nature is known as a) Fluctuating load b) Repeated load c) Cyclic load d) suddenly applied load	2	2	R
3	Fluid statics deals with a) Viscous and pressure force b) Viscous and gravity force c) Gravity and pressure force d) Surface tension and gravity force	3	3	U
4	Orifice can be classified according to the discharge condition as a) Bell mouthed orifice b) Fully submerged orifice c) Small orifice d) Sharp edged orifice	4	4	U

5	Difference between theoretical discharge to the actual discharge is a) Coefficient of discharge b) Separation c) Slip d) Volumetric efficiency	5	5	R
Part- B				
Answer all questions. Each sub division carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	Classify engineering materials	1	1	U
6b	Define resilience	1	1	R
7a	Distinguish between Centre and Centroid.	2	2	U
7b	State parallel axis theorem.	2	2	U
8a	Define cohesion and adhesion with an example	3	3	R
8b	Define absolute pressure.	3	3	R
9a	Define wetted perimeter.	4	4	R
9b	Define hydraulic radius.	4	4	R
10a	State the impact of jet	5	5	R
10b	State the use of surge tank?	5	5	U
PART-C				
Answer all questions, choose any one question from each division (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level

11a	A steel bar of 25mm diameter and a length of 1m is subjected to a pull of 25kN. If $E=2 \times 10^6 \text{ N/mm}^2$, Find the elongation, change in diameter and the increase in volume of the bar. Take $1/m=4$	1	1	Ap
OR				
11b	A metal bar 50mm X 50mm section is subjected to an axial compressive load of 500kN. The contraction of a 200mm gauge length is found to be 0.5mm and increase in thickness is 0.04mm. Find the value of E and $1/m$.	1	1	Ap
12a	Discuss in detail on behavior of metal (M.S rod) in tension up to rupture	2	2	U
OR				
12b	Find the Centroid of I section having the top flange 100mm X 20mm, web 150mm X 10mm and the bottom flange 200mm X 20mm	2	2	Ap
13a	Explain the working of simple u-tube manometer with a neat sketch	3	3	U
OR				
13b	A differential manometer is connected at two points A and B in a horizontal pipe line containing an oil of specific gravity 0.8 and the pressure difference in mercury level is 125mm. Determine the difference in pressure at two points in terms of head of water in meters and kN/m^2 .	3	3	Ap
14a	State and prove Bernoulli's theorem	4	4	U
OR				

14b	Two reservoirs are connected by a pipe line 3km long. Diameter of the pipe is 0.5m. The difference of water level in the reservoir is 10m.find the discharge in lit/mt. Assume $f=0.01$.Ignore all other losses the friction.	4	4	Ap
15a	Explain the construction working of centrifugal pump with a neat sketch	5	5	U
OR				
15b	In a single acting reciprocating pump, The diameter of cylinder is 152mm and the stroke is 304mm.The water is raised through a height of 18m at a pump speed of 40rpm. Calculate the theoretical power required and the discharge in liters per second. If the actual discharge is $0.2122\text{m}^3/\text{mt}$, Determine the co efficient of discharge and percentage slip	5	5	Ap

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be Implemented from the Academic Year 2022-2023 Onwards)**

Programme : Mechanical Engineering (R&AC)

Term : III

Course Code : 2203

Course Name : Manufacturing Processes

Number of hours per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
2203	Manufacturing Processes	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total : 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Casting Processes	15	0	0	15
2	Joining Processes	12	0	0	12
3	Metals and Heat Treatment Processes	13	0	0	13
4	Forming and Powder Metallurgy	13	0	0	13
5	Plastic Processing	11	0	0	11
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to,

1. Select suitable foundry process to manufacture a component. (Unit 1)
2. Select suitable welding process to join the given material. (Unit 2)
3. Explain the significance and application of heat treatment process of metals. (Unit 3)
4. Select suitable forming methods in manufacturing a component.(Unit 4)
5. Explain the various methods of producing plastic components. (Unit 5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	CASTING PROCESSES	15	0	0
	1.1 : Patterns Definition – types of pattern - solid piece- split piece – loose piece - pattern materials- pattern allowances.	2	0	0
	1.2 :Moulding Definition - Moulding sand – constituents – properties of moulding sand – types of moulds – green sand mould – dry sand mould – methods of moulding – moulding machines– jolting – squeezing machine construction and working principle.	4	0	0
	1.3 :Cores Essential qualities of core – materials – core sand preparation – core binders – core gases - CO ₂ process core making – core shooter – core print - Chaplets and Chills	2	0	0
	1.4 :Casting: Shell mould casting – investment casting – pressure die casting – hot chamber die casting – cold chamber die casting – gravity die casting – centrifugal casting –	7	0	0

	continuous casting - Arc furnaces - Induction furnace – working principles- cleaning of casting - defects in casting – causes and remedies - safety practices in foundry.			
2	JOINING PROCESSES	12	0	0
	Joining- Importance of Welding-Arc welding process- Polarity-Classification of Arc welding process-arc welding principle and Applications - SMAW, GTAW, GMAW - Submerged Arc Welding(SAW) -Types of Welded Joints-Welding Procedure- Gas welding process [Oxy acetylene Welding]-Types of Flames - Plasma arc welding – Thermit welding – Electron beam welding – Laser beam welding- Electrical resistance welding (ERW) - Welding formula - Spot and Seam Welding- defects in welding - soldering and brazing - safety practices in welding	12	0	0
3	METALS AND HEAT TREATMENT PROCESSES	13	0	0
	Steels - low, medium and high carbon steel , stainless steel, HSS - SG iron Aluminum – Aluminum alloys – Duralumin, Y Alloy - Copper - Copper alloys – Brass, Bronze, Gun Metal composition, properties, characteristics, common applications. Effect of alloying elements on properties of steel.	6	0	0
	Phase diagrams: Iron carbon equilibrium diagram - micro constituents of iron carbon alloys - Ferrite - Austenite - cementite - pearlite - ledeburite - martensite. Effect of carbon on properties of steel.	4	0	0
	Heat Treatment Processes: Purpose - Annealing - full annealing, process - Normalizing- Hardening- Tempering.	3	0	0
4	FORMING AND POWDER METALLURGY	13	0	0
	4.1 : Forming Introduction -Forging materials -Heating devices -	4	0	0

	Forging temperatures -forging tools - forging processes -hand forging - smith forging - power forging -impression die forging - press forging -roll die forging - advantages and limitations of forging - safety practices in forging.			
	4.2 : Press Working: Introduction -Types of presses –Power press parts -Power press driving mechanism - Press tools and accessories -Die accessories - press working operations -bending operations - angle bending , channel bending, forming operations - coining, embossing, bulging, drawing, seaming - shearing operations - blanking, piercing, punching , trimming, notching, , lancing , slitting, shaving - safety practices.	4	0	0
	4.3 : Powder Metallurgy Metal powders – atomization, reduction and electrolysis deposition – blending - compacting – sintering – sizing – infiltration . Mechanical properties of parts made by powder metallurgy	5	0	0
5	PLASTIC PROCESSING	11	0	0
	Plastics: Definition - types - Thermosetting & thermo plastics - Characteristics - merits and demerits, Mechanical properties - degradation - wear resistance - Durability-frictional properties - Selection of plastics .	3	0	0
	Extrusion-general features of single screw extrusion - twin screw extruders and types-Injection molding types: Plunger type - Reciprocating screw injection. Structural foam injection mould . Extrusion process-sandwich moulding - gas injection moulding – injection moulding of thermosetting materials - calendaring and rotational moulding - Design consideration for plastic components - safety practices	8	0	0

TEXT BOOKS:

1. Hajra Chowdry & Bhattacharya (2nd Edition) ," Elements of workshop Technology" Volume I & II - Media Promoters & Publishers Pvt. Ltd.,
2. R.S.Khurmi & J. K. Gupta (2nd Edition) ,"A Text book of workshop Technology", S.Chand Publications.
3. O. P. Khanna " Material Science & Metallurgy " , Dhanpat Rai Publications 2014.
4. R K Jain (2nd Edition) , " Engineering Metrology ", Khanna Publication

REFERENCE BOOKS:

1. P. C. SHARMA (10th Edition), "Production Technology", S.Chand & Co. Ltd.,
2. Serope kalpakjian & Steven R.Schmid, "Manufacturing engineering and technology" ,Pearson Publication,2001.
3. Sidney H Avner (2nd Edition), " Introduction To Physical Metallurgy", TATA Mcgraw Higher Ed
4. Luqman Midhat "Plastics Technology" CBS Publishers & Distributors, 2012.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time : 3 Hrs

Max. Marks : 75

Pattern of the Question Paper :

PART A - 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B - 5 Questions with two subdivisions taken from each unit. Each question carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	5	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Name : 2203 - Manufacturing Processes

Duration: 3 hours

Max. Marks: 75

Part- A				
Objective Questions: Answer all Question				(5X1= 5 Marks)
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	Crucible furnace is used for melting of a) Cast iron b) Copper base alloys c) Cast steel d) Non-ferrous metal	1	1	U
2	Heat is created by chemical reaction in a) Resistance welding b) Oxy-acetylene welding c) Tungsten arc welding d) Thermit welding	2	2	R
3	The process used for relieving the internal stresses previously set up in the metal and for increasing the machinability of steel is a) Normalizing b) full annealing c) Process annealing d) spheroid sink annealing	3	3	U
4	Swaging is an operation of _____ a) Hot rolling b) Forging c) Extrusion d) Piercing	4	4	R
5	Telephone receivers are manufactured by ____ moulding  a) Injection b) Extrusion c) Blow d) Calendaring	5	5	U

Part- B				
Answer all questions: Each sub division carries 2 marks				
(10X2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6 a)	List out the properties of Moulding sand.	1	1	R
6 b)	Mention the applications of centrifugal casting.	1	1	U
7 a)	List out the types of resistance welding?	2	2	R
7 b)	Distinguish between soldering and brazing.	2	2	U
8 a)	List the information obtained from phase diagram	3	3	R
8 b)	Compare annealing and normalizing process.	3	3	U
9 a)	Mention any four cutting operations in a press work	4	4	R
9 b)	List out the step by step procedure for making products in powder metallurgy.	4	4	R
10 a)	Write any two differences between thermo plastics and thermosets.	5	5	U
10 b)	List the types of Plastic Manufacturing methods	5	5	R
Part- C				
Answer all questions, choosing any one division from each question.				
(5x10=50 Marks)				
Q. No	Question	CO No.	Unit No.	Blooms Level
11 a)	Explain hot chamber and cold chamber die casting process with a neat sketch.	1	1	U
OR				
11 b)	Select suitable casting process for the given component. Explain the process with suitable sketches.	1	1	Ap

				
12 a)	Select suitable welding process being carried out on the aluminium Plate .	2	2	U
OR				
12 b)	Explain with a neat sketch about Laser beam welding process. State its advantages.	2	2	U
13 a)	Describe the composition, properties and application of Aluminium and its alloys	3	3	U
OR				
13 b)	Draw Iron-Carbon diagram and explain its features	3	3	U
14 a)	Explain the following forging operations: a) Upset forging b) Roll forging c) Drop forging	4	4	U
OR				
14 b)	Explain with neat sketches about any five types of shearing operations.	4	2	U
15 a)	Explain the plastic moulding process for manufacturing the below mentioned component with a neat sketch 	5	5	U
OR				

15 b)	Explain the process of gas injection moulding with a neat sketch.	5	5	U
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Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : III

Course Code : 9301

Course Title : R & AC Machines

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9301	R&AC Machines	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Compressors	13	0	0	13
2	Condensers	13	0	0	13
3	Cooling Towers and fans	13	0	0	13
4	Evaporators	13	0	0	13
5	Expansion Devices and Filters	13	0	0	13
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Demonstrate the working of compressors used in R & AC systems (UNIT-1)
2. Demonstrate the working of condensers used in R & AC systems (UNIT-2)
3. Demonstrate the working of Cooling towers and fans used in R & AC systems (UNIT-3)
4. Demonstrate the working of Evaporators used in R & AC systems (UNIT-4)
5. Demonstrate the expansion devices and air filters used in R & AC systems (UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	COMPRESSORS	13	0	0
	Main functions of a compressor, classification of compressors. Reciprocating compressor – Construction & working of single acting single stage reciprocating compressor- Hermetically sealed compressor – construction, working and advantages over open type reciprocating compressor. Rotary compressors – Roller (single stationary blade) compressor construction, working and advantages, Vane (rotary blade) compressor construction, working and advantages. Centrifugal compressor – construction working and advantages- Screw compressor construction, working and advantages- Scroll compressor construction, working and advantages-Applications of Reciprocating, Sealed, Rotary, Centrifugal, Screw and Scroll compressors-No problems and no derivations.			
2	CONDENSERS	13	0	0
	Condenser – function of condensers, condensing or cooling mediums. Factors affecting the condensing capacity – Material, amount of contact and			

	temperature difference. Types of condensers – air cooled, water cooled, evaporative condensers. construction & working of natural convection air cooled condensers, types of forced convection air-cooled condensers, Base mounted and remote air – cooled condensers, Water cooled condensers – waste water system, re-circulated water system, water circuit connected for series flow, water circuit connected for parallel flow, fouling rates, factors influencing fouling rates. Construction working & applications of double tube or tube- in-tube, shell-and –coil, and shell-and tube – cooled condensers. Evaporative condenser – cooling mediums, construction and working-No problems and no derivations.			
3	COOLING TOWERS AND FANS	13	0	0
	3.1 Cooling Towers: Function of a cooling tower, concept of Range and Approach, basic principle involved in cooling of water, capacity of cooling tower, Types of cooling towers – construction & working of Natural draft of atmospheric spray tower, types of Mechanical draft cooling towers – construction and working of forced, draft cooling tower & induced draft cooling tower. No problems and no derivations	7	0	0
	3.2 Fans: Function of fans, fan laws, types of fans – construction and working of centrifugal fans – backward carried radial and forward curved fans. Construction and working of Axial flow fans – propeller fan, tube axial fan and vane axial fan. Fan arrangements – fans in series, fans in parallel. Anemometer. No problems &No derivations	6	0	0
4	EVAPORATORS	13	0	0
	Function of evaporator. Factors affecting the heat			

	transfer capacity of an evaporator - Material, Contact surface, Thickness, velocity and Temperature difference. Classification of evaporator, Construction working and advantages of bare tube coil evaporator, finned evaporator, plate evaporator. Liquid chillers – Construction working and advantages of Shell and tube evaporator, Shell and coil evaporator, Tube in Tube evaporator, Flooded evaporator, Dry expansion evaporator, Natural convection evaporator, Forced convection evaporator. No problems and no derivations.			
5	EXPANSION DEVICES AND FILTERS	13	0	0
	5.1 Expansion devices: Basic functions of expansion devices, Types of expansion devices, Construction and working of Capillary tube expansion devices, Automatic or constant pressure expansion valve, Thermostatic expansion valve, necessity of TEV with internal equalizer, necessity of TEV with external equalizer. Flooded evaporator control – construction and working of low-side float valve, High side float valve. No problems and no derivations	7	0	0
	5.2 Filters: Function of filters, impurities in air – dust, fumes, smoke, fogs, pollens, bacteria. Effects of dust on health. Methods of cleaning air – air filtration, sterilization, ionization odour suppression. Air filters – types- Dry filters, viscous filters, wet filters, electric filters, HEPA filter-filter rating “MERV”- No problems and no derivations.	6	0	0

TEXT BOOKS:

1. C.P.Arora, “Refrigeration and Air-conditioning”, TaTa McGraw Hill Publishing Company Ltd., 2018
2. R.S. Khurmi and J.K. Gupta, “A text book of refrigeration and air conditioning”.

S. Chand Company Ltd, 2019.

3. A.I.Khandwawala and G.Maheshwari" Refrigeration and Air conditioning" Jain brothers company ltd 2018

REFERENCE BOOKS:

1. Tomeczyk Silberstein and Whitman Johnson,"Refrigeration and Air conditioning Technology" cengage learning
2. Arora and Domkundwar, "A course in Refrigeration and Air-Conditioning , Dhanpat Rai & Co. Ltd, 2018.
3. P N Ananthanarayanan," Basic Refrigeration and Air conditioning" McGraw Hill Publishing Company Ltd.,2019

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9301 - R&AC MACHINES**Time: 3 Hrs**

Marks : 75

Part- A				
Objective Questions: Answer all Questions (5x1= 5 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	A good compressor has a volumetric efficiency of a) 70-80 % b) 10-20 % c) 20-30% d) 40-50%	1	1	R
2	A domestic refrigerator uses a)natural convection air cooled condenser b)shell and coil type condenser c)forced convection air cooled condenser d)double pipe condenser	2	2	U
3	Choose the type of cooling system is used in the large power plants a)cooling ponds b)Natural flow system c)Cooling towers d) Single deck system	3	3	R
4	Evaporator used in household refrigerator is a)frosting evaporator b)non frosting evaporator efrosting evaporator d)flooded evaporator	4	4	R
5	In liquid chillers, when the liquid to be chilled is in the shell, refrigerant which flows through the tubes is fitted with the following valve a) Automatic expansion valve b)capillary tube c)thermostatic expansion valve d) float valve	5	5	R

Part- B				
Answer all questions. Each subdivision carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	State the purpose of compressor.	1	1	R
6b	List the applications of scroll compressor	1	1	U
7a	Define counter flow system	2	2	R
7b	Compare air cooled and water cooled condenser	2	2	U
8a	State the purpose of cooling tower.	3	3	R
8b	Define function of fan.	3	3	R
9a	Define prime surface evaporators	4	4	R
9b	State the functions free convection evaporator	4	4	U
10a	Name the methods of cleaning the air	5	5	R
10b	Define anemometer	5	5	R
PART-C				
Answer all questions, choosing any one Question from each division (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	Explain Rotary compressor with neat sketch.	1	1	U
OR				
11b	Explain Screw compressor with neat sketch.	1	1	U
12a	Explain the following (i) Waste water system (ii) Re circulated water system	2	2	U
OR				

12b	Explain the following (i) Fouling factor (ii) Shell and coil condenser	2	2	U
13a	Explain natural draft atmospheric spray type cooling tower	3	3	U
OR				
13b	State the function of fans. Describe propeller fan and tube axial fan.	3	3	U
14a	Explain construction, working and advantages of bare tube coil evaporator.	4	4	U
OR				
14b	Explain dry expansion evaporator with neat sketch.	4	4	U
15a	Explain thermostatic expansion valve with neat sketch.	5	5	U
OR				
15b	Explain the following in detail i) Odour suppression ii) Dry filters	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : III

Course Code : 9202

Course Title : Thermal Engineering

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9202	Thermal Engineering	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Thermodynamics and Expansion of Gases	14	0	0	14
2	Steady Flow Energy Equation and Air Cycles	13	0	0	13
3	I.C Engines and Performance	13	0	0	13
4	Air Compressors	13	0	0	13
5	Energy Engineering and Steam Boilers	12	0	0	12
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Solve problems on thermodynamic processes (UNIT-I)
2. Apply steady state energy equation to various open systems and apply Thermodynamics process to various air standard cycles(UNIT-II)
3. Calculate the performance of IC engine(UNIT-III)
4. Calculate the performance of air compressor (UNIT-IV)
5. Explain various renewable and non-renewable energy sources and working of boilers (UNIT-V)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
	THERMODYNAMICS AND EXPANSION OF GASES	14	0	0
1	1.1 Thermodynamics: Introduction - definitions and units of mass, weight, volume, density, specific weight and specific gravity - pressure - units - atmospheric, gauge, vacuum and absolute pressure - temperature- Celsius and absolute temperature - S.T.P and N.T.P conditions - heat - specific heat capacity at constant volume and at - constant pressure - work - power - energy - types - thermodynamic system - types - properties and state of system - intensive and extensive properties - thermodynamic process - cycle - point and path functions - law of conservation of energy - equilibrium - thermodynamic equilibrium - zeroth , first and second laws of thermodynamics - problems Perfect gases - laws of perfect gases - Boyle's, Charles' , Joule's, Regnault's and Avogadro's laws - characteristic gas equation - relation between specific heats and gas constant - universal gas constant - problems - enthalpy - change in enthalpy - entropy -	7	0	0

	change in entropy - general equations for change in entropy. No derivations only problems.			
	1.2 Expansion Of Gases: Expansion of gases - thermodynamic processes - constant volume, constant pressure , isothermal (hyperbolic) , isentropic(reversible adiabatic) , - polytropic, free expansion and throttling processes – P-V and T-S diagrams, work done , change in internal energy , heat transfer , change in enthalpy , change in entropy for various processes. No derivations only problems.	7	0	0
	STEADY FLOW ENERGY EQUATION AND AIR CYCLES	13	0	0
	2.1 Steady Flow Energy Equation: Steady flow system - control volume - steady flow energy equation - applications - steam boiler - condenser - nozzles - steam and gas turbines - - reciprocating and rotary compressors -(No derivation) - non flow energy equation - problems.	5	0	0
2	2.2 Air Cycles : Air cycles - air standard efficiency - reversible and irreversible processes - thermodynamic reversibility - conditions of reversibility - assumptions in deriving air standard efficiency - Carnot cycle - Otto cycle - Joule cycle - Diesel cycle - comparison of Otto cycle and Diesel cycle - ideal and actual p-V diagrams of Otto and Diesel cycles - comparison - No derivations – problems	8	0	0

3	I.C ENGINES & PERFORMANCE	13	0	0
	3.1 I.C Engines : Introduction - classifications - four stroke cycle petrol and diesel engines - constructional details of I.C. engine - Fuels-classifications-HCV-LCV (Description only) - super charging - effects and applications - turbo charger. Cooling system-necessity-types-air cooling-liquid cooling- working principle Lubrication - purpose - properties of lubricants –full pressure lubrication system - oil pump and oil filters	6	0	0
	3.2 Performance Of I C Engines: Performance of I.C engines - Test)ing - thermodynamic and commercial tests - indicated power - brake power - friction power - efficiencies of I.C. engines - indicated thermal, brake thermal, mechanical and relative efficiencies - Morse test - procedure - problems - heat balance sheet – Simple problems	7	0	0
4	AIR COMPRESSORS	13	0	0
	Air compressors - uses of compressed air - classifications of compressor - working principle of a compressor - single stage reciprocating compressor - - compression processes - power required to drive the compressor – simple problems - clearance volume and its effects - volumetric efficiency -(No derivation) - power required to drive the compressor with clearance volume - problems - multi stage air compressor - merits and demerits - intercooler - perfect inter cooling - work input on multi stage compressor -(No derivation) - problems .			

5	ENERGY ENGINEERING AND STEAM BOILERS	12	0	0
	5.1 Non Renewable Sources Of Energy: Layout of Diesel engine power plant-Thermal power plant-Nuclear power plant, hydro power plant.	4	0	0
	5.2 Renewable Sources Of Energy: Solar energy-Wind energy - Geothermal energy-Bio gas	3	0	0
	5.3 Steam Boilers: Introduction-classification of boilers-comparison of fire tube and water tube boilers-high pressure boilers-advantages of high pressure boilers-working off BHEL high pressure boilers, Lamont boiler.	5	0	0

TEXT BOOKS:

1. P.K.Nag, "Applied Thermodynamics", Tata Mcgraw Hill, 2004.
2. Ballaney.P.L, "Thermal Engineering", Khanna Publishers, 2003.

REFERENCE BOOKS:

1. Khurmi.R.S, "Thermal Engineering", S.Chand & Company, 2002.
2. Domkundwar, "Course in Thermodynamics and Heat Engines", 2004.
3. Renewable Energy Sources - Twidell, J.W. and Weir, A. - EFN Spon Ltd., 1986,

AUTONOMOUS EXAMINATION – QUESTION PATTERN

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PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9202-THERMAL ENGINEERING

Time: 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	The internal energy of a substance depends on a) temperature b) pressure c) volume d) entropy	1	1	U
2	The ratio of total volume to clearance volume is known as a) compression ratio b) cut off ratio c) air standard efficiency d) volumetric efficiency	2	2	R
3	Air fuel ratio for idling speed of a petrol engine is approximately a) 1:1 b) 5:1 c) 10:1 d) 15:1	3	3	R
4	Inter cooling in multi stage compressor is done a) to cool the air during compression b) to cool the air at delivery c) to enable compression in 2 stage d) to minimize the work of compression	4	4	U
5	Following energy is derived from heated ground water a) solar energy b) geo thermal energy c) hydro electric energy d) nuclear energy	5	5	R
Part- B				
Answer all questions. Each subdivision carries 2marks			(10x2=20 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level

6a	Define Clausius statement	1	1	R
6b	Draw P-V and T-S diagram for constant pressure process	1	1	U
7a	State the assumptions made in the SFE equation?	2	2	R
7b	While undergoing a Carnot cycle, the working fluid receives heat at a temperature of 317°C and reject heat at a temperature of 22°C. Find the theoretical efficiency of the cycle.	2	2	Ap
8a	Define carburation and also state the requirements of a carburetor.	3	3	R
8b	Define brake power and indicated power	3	3	R
9a	State the effect of clearance volume in a volumetric efficiency of a compressor	4	4	R
9b	Write the advantages of intercooler in the multi stage air compressor	4	4	R
10a	Define nuclear fission process	5	5	R
10b	Compare fire tube and water tube boiler.	5	5	U
PART-C				
Answer all questions, choosing any one Question division from each division (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	2 kg of a gas at 50°C is heated at constant volume until the pressure is doubled. Determine 1) final temperature 2) change in internal energy 3) change in enthalpy 4) change in entropy. Assume $C_p = 1.005 \text{ kJ/kg K}$ and $C_v = 0.71 \text{ kJ/kg K}$.	1	1	Ap
OR				

11b	0.5 kg of air at 180°C expands adiabatically to 3 times its original volume. During the expansion, the temperature is decreased to 20°C. Work done during expansion is 53 kNm. Find C_p , C_v and R .	1	1	Ap
12a	In a diesel cycle the compression ratio is 13:1 and the fuel is cut – off at 8% of the stroke. Find the air standard efficiency of the engine. Take $\gamma=1.4$ for air.	2	2	Ap
OR				
12b	In an air standard Brayton cycle, the air enters the compressor at 100 kN/m ² and 15°C. The pressure of air leaving the compressor is 500 kN/m ² . The maximum temperature of the cycle is limited to 900°C. Determine: 1) pressure and temperature at each point of the cycle. 2) work done of the cycle	2	2	Ap
13a	Explain the working principle of liquid cooling system.	3	3	U
OR				
13b	The following results were obtained during a Morse test on a four stroke petrol engine. BP with all cylinders working = 11.92 kW BP with cylinder 1 cut out = 8.46 kW BP with cylinder 2 cut out = 8.60 kW BP with cylinder 3 cut out = 8.54 kW BP with cylinder 4 cut out = 8.50 kW. Calculate the mechanical efficiency of the engine. If the fuel consumption is 3.5 kg/hour, find the indicated thermal efficiency and Calorific value of fuel is 42000 kJ/kg.	3	3	Ap
14a	A compressor compresses air from 100 kN/m ² . The clearance volume is 2.13 litres and compression	4	4	Ap

	and expansion are polytropic, $n=1.3$ for each. If the volumetric efficiency of the compressor is 85%, determine 1) the stroke volume 2) the diameter of the cylinder if the length of stroke is 300mm.			
OR				
14b	Determine the power required by a two stage compressor with perfect inter cooling with a suction pressure of 1 bar and temperature of 0°C and the final pressure is 25 bar. The volume of air handled at inlet conditions is 30m ³ /hr. The law of compression is $PV^{1.3} = C$ constant.	4	4	Ap
15a	Describe the layout of nuclear power plant with a neat sketch.	5	5	U
OR				
15b	Explain the BHEL boiler with a neat sketch.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)
Term : III
Course Code : 9203
Course Title : Strength of Materials and Fluid Mechanics Practical
Number of Periods per week: 4
Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9203	Strength of Materials And Fluid Mechanics Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Calculate strength parameters of various metals
2. Verify Bernoulli's theorem and applications
3. Calculate friction factor of pipe
4. Determine the efficiency of the pumps
5. Calculate co- efficient of discharge of Orifice

9203 - STRENGTH OF MATERIALS AND FLUID MECHANICS PRACTICAL

LIST OF EXPERIMENTS

I. STRENGTH OF MATERIALS

1) Test on Ductile Materials:

Determine Young's modulus, yield points, percentage elongation and percentage reduction in area, plotting of stress-strain diagram-- tests on Mild steel

2) Hardness Test:

Determine Rockwell's hardness number for various materials like Mild steel, high carbon steel, Brass, Copper and Aluminum

3) Torsion Test:

Perform Torsion test on Mild steel, relation between torque and angle of twist and determine shear modulus, determination of shear stress

4) Impact test:

Determine resistance of materials to impact loads by IZOD test or CHARPY test.

5) Shear Test:

Perform Shear test on Mild Steel bar and determine the resistance of material to shear load.

II. FLUID MECHANICS

1) Bernoulli's theorem:

Verify Bernoulli's theorem

2) Venturi Meter / Orifice meter:

Determine the coefficient of discharge

3) Pipe friction:

Determine the friction factor in a pipe

4) Reciprocating pump:

Determine the efficiency of reciprocating pump (Characteristic curves)

5) Centrifugal pump:

Determine the efficiency of centrifugal pump (Characteristic curves)

6) Small orifice:

Determine the coefficient of discharge through Small orifice by constant head method and variable head method

SCHEME OF EVALUATION FOR END TERM EXAMINATION:

S .NO	CONTENTS	MARKS ALLOTTED
1	Formula and Tabulation	15
2	Observation (readings) & Procedure	20
3	Model calculation& Graph	30
4	Result	5
5	Viva-voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : III

Course Code : 9302

Course Title : R&AC Machines Practical

Number of Periods per week: 4

Total Number of weeks per term: 16

Scheme of Examination

Course Name	Course Code	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
R&AC Machines Practical	9302	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Set and vary various operating parameters of R & AC systems.
2. Dismantle and Assemble Compressor component.
3. Determine efficiency and capacity of R & AC system.

9302-R & A/C MACHINES PRACTICAL

PART-A

1. Identify the Service tools of Refrigeration and Air-conditioning system
2. Set and adjust thermostat in refrigerator
3. Set and adjust low pressure and high pressure Cut out in Refrigerator & Air Conditioner.
4. Set and adjust Automatic expansion valve in refrigerator

- Set and adjust Thermostatic expansion valve in refrigerator

PART-B

- Determine the efficiency of blower.
- Determine the capacity of cooling coil of window Air Conditioner
- Dismantle and assemble the hermetically sealed compressor.
- Dismantle and assemble of open type compressor.
- Test the pumping capacity of open type and sealed compressor in refrigeration and Air Conditioning
- Conduct Performance test on compressor with (VFD) variable frequency driven motor

SCHEME OF EVALUATION FOR END TERM EXAMINATION

SI. NO.	CONTENTS	MARKS ALLOTTED
I	<u>PART-A:</u> Operation	20
II	<u>PART-B:EXPERIMENT:</u>	
1	Formula & Tabulation	10
2	Observation (Readings) & Procedure	15
3	Calculation/Graph	20
4	Result	5
5	Viva Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : III

Course Code : 9204

Course Title : Thermal Engineering Practical

Number of Periods per week : 4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9204	Thermal Engineering Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Calculate thermodynamic property of the given oil
2. Calculate the performance of I.C Engine
3. Calculate the Volumetric efficiency of Reciprocating Air compressor

9204 –THERMAL ENGINEERING PRACTICAL

LIST OF EXPERIMENTS

EXPERIMENTS:

I. TESTING OF LUBRICATION OIL

1. Determine the flash and fire points of the given oil using open and closed cup apparatus.
2. Determine the absolute viscosity of the given lubricating oil using Redwood

Viscometer.

3. Determine the absolute viscosity of the given lubricating oil using Say bolt viscometer.

II. I.C ENGINES

1. Determine the Valve timing diagram of four stroke cycle in Petrol engine.
2. Determine the Port timing diagram of two - stroke cycle in Petrol engine.
3. Perform the Load test on Petrol engine.
4. Perform the Load test on Diesel engine.
5. Perform the Morse test on multi cylinder Petrol engine.
6. Prepare Heat balance sheet on Petrol engine.

III. COMPRESSOR

1. Determine the Volumetric efficiency of Reciprocating Air compressor.

SCHEME OF EXAMINATION

S NO	CONTENTS	MARKS ALLOTTED
1	Formula, Tabulation	15
2	Observation (Readings) & Procedure	20
3	Calculation, Graph	30
4	Result	5
5	Viva-Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : III
Course Code : PS03
Course Title : Professional Skills (Personal Effectiveness)
Number of Periods per week : 1
Total Number of weeks per term : 16

SCHEME OF INSTRUCTIONS AND EXAMINATION

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
PS03	Professional Skills (Personal Effectiveness)	-	-	-	-

TOPICS AND ALLOCATION OF PERIODS**L - T - P: 1 - 0 - 0 Periods / Week****Total: 16 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	The importance of envisioning	3	0	0	3
2	Fundamental principles of goal setting and working to time	2	0	0	2
3	Goal setting and action orientation	3	0	0	3
4	Time management - tools and techniques	3	0	0	3
5	Putting into practice	2	0	0	2
Evaluation					3
Total					16

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. Identify the strengths, weaknesses and opportunities.
2. Set well-articulated goals for academics, career, and personal aspirations.
3. Establish the road map to realize the goals.
4. Apply time management techniques to complete planned tasks on time.
5. Create time and pursue activities of self-interest that add value.

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	THE IMPORTANCE OF ENVISIONING	3	0	0
	Importance of positive self-perception – Principle of dual creation (Everything gets created twice – Envisioning) - Understanding vision and mission statements - Writing personal mission statements – ‘Focus’ as a way of life of most successful people – Importance of goal setting – Importance of planning and working to time	3	0	0
2	FUNDAMENTAL PRINCIPLES OF GOAL SETTING AND WORKING TO TIME	2	0	0
	Clarifying personal values, interests and orientations – Awareness of opportunities ahead – Personal SWOT analysis - Principles driving goal setting: Principle of response and stimuli, Circle of influence and circle of concern, What you see depends on the role you assume	2	0	0
3	GOAL SETTING AND ACTION ORIENTATION	3	0	0
	Potential obstacles to setting and reaching your goals - Five steps to goals setting: SMART goals, Inclusive goals, Positive stretch, Pain vs gain, Gun-point commitment – Importance of action orientation - Converting goals to actionable tasks – Establishing road map – Using Gantt chart for planning and progress	3	0	0

4	TIME MANAGEMENT - TOOLS AND TECHNIQUES	3	0	0
	Pareto 80-20 principle of prioritization – Time quadrants as a way to prioritize weekly tasks – The glass jar principle - Handling time wasters – Assertiveness, the art of saying ‘NO’ – Managing procrastination	3	0	0
5	PUTTING INTO PRACTICE	2	0	0
	Practicals: Using the weekly journal – Executing and achieving short term goals – Periodic reviews	2	0	0

Course hand outs (compiled by PS team)

- 1) Learner’s workbook
- 2) Personal effectiveness journal
- 3) Reading material for Personal Effectiveness

REFERENCE BOOKS:

- 1) Stephen R Covey, “First things first”, Simon & Schuster Uk, Aug 1997.
- 2) Sean Covey, “Seven habits of highly effective teenagers”, Simon & Schuster Uk, 2004.
- 3) College student's guide to time management (e-book)
- 4) Michael S Dobson, Susan B Wilson, “Goal setting” (e-book)

Tests and Grading

Sl. No.	Evaluation	Criterion	Total marks	
1	Course Evaluation	Comprehensive Examination and Viva voce	KT* & SKT*, Short questions	20 marks
			Viva voce	05 marks
			Total	25 marks

*KT = Knowledge Test, SKT = Scenario based Knowledge Test

Grade

- 1) Marks between 25 to 20 – Excellent
- 2) Marks between 19 to 15 – very good
- 3) Marks between 14 to 10 good
- 4) Marks below 10 satisfactory

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : IV

Course Title : Heat Transfer

Course Code : 9303

Number of periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9303	Heat Transfer	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Hours)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Conduction.	15			15
2	Forced Convection	12			12
3	Natural convection, Boiling and Condensation	12			12
4	Heat Exchanger	14			14
5	Radiation	12			12
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Calculate heat transfer by conduction. (UNIT-1)
2. Calculate heat transfer by forced convection (UNIT-2)
3. Calculate heat transfer by Natural convection (UNIT-3)
4. Calculate the performance of heat exchangers. (UNIT-4)
5. Solve heat transfer in radiation shields (UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	CONDUCTION	15	0	0
	Basic concepts-Difference between Thermodynamics and heat transfer- Basic laws governing heat transfer- Modes of heat transfer – Fourier’s Law of conduction –Thermal conductivity of materials- Conduction through Slab – Conduction through composite slab – Overall heat transfer coefficient - Conduction through hollow and composite pipes – conduction through hollow and composite sphere - Simple problems Applied in R&AC fields- Conductors and insulators – Critical thickness of insulation for cylinder.			
2	FORCED CONVECTION	12	0	0
	Laminar flow – Turbulent flow – Remolds experiment - Non dimensional numbers used in natural convection- Boundary layer concept- definition and characteristics of boundary layer- Thermal boundary layer - Simple problems to find heat transfer using forced convection			
	NATURAL CONVECTION, BOILING AND CONDENSATION	12	0	0

3	3.1 Natural Convection: Basic concepts-Newton's law of convection – Viscosity – Natural convection – Non dimensional numbers used in natural convection - Simple problems to find the rate of heat transfer in vertical pipes and vertical plates in free convection.	8	0	0
	3.2 Boiling and Condensation: Boiling heat transfer – Regimes of Boiling (No problems, No derivations) Modes of condensation – Film wise condensation – Drop wise condensation.	4	0	0
4	HEAT EXCHANGER	14	0	0
	Introduction – Types of heat exchanger – Logarithmic Mean temperature difference (LMTD) – parallel flow – counter flow – cross flow heat exchanger (No derivation) – LMTD method –Overall Heat Transfer Coefficient - Correction factor for multi pass Heat exchanger – Fouling – Effectiveness and Number of Transfer Units (NTU) (No derivation) – Simple problems applicable to R&AC field.			
5	RADIATION	12	0	0
	Radiation —Radiation properties- Reflection, Absorption &transmittance of Radiation – Black body concept – Grey body concept – Stefan's bolts man constant –Kirchhoff's law-Plank's law- Wien displacement law-Intensity of radiation and Lambert's Cosine law – Simple problems – No derivation. View Factor-Radiation Shields and Radiation Effect - No derivation- Simple problems in radiation shields only.			

TEXT BOOKS:

1. R.K.Rajput, "Heat and Mass Transfer (SI units)", S. Chand publications, 2018 (Revised Edition).
2. Arora, Domkundwar, "A course in Heat and Mass Transfer (S.I Units)", Dhanpat Rai & Co pvt ltd, 2007.
3. C.P.Kothandaraman, "Fundamentals of Heat and Mass Transfer." New Age International Publishers, 2012.

REFERENCE BOOKS:

1. YunusA.Cengel, AfshinJ.Ghajar, "Heat and Mass Transfer", McGraw Hill Education, 2020.
2. P.K Nag, "Heat and Mass Transfer", McGraw Hill Education, 2011.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A - 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B - 5 Questions with two subdivisions taken from each unit. Each question carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9303 - HEAT TRANSFER

Time: 3 Hrs

Marks: 75

Part- A				
Objective Questions: Answer all Questions			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Bloom s Level
1	Heat transfer takes place as per the following law of thermodynamics a) Zeroth law b) First c) Second d) Fourier law	1	1	U
2	Least number of Prandtl number is expected in a) Water b) Liquid metals c) Salt solution d) Sugar solution	2	2	R
3	Heat transfer in Liquid and gases take place by a) Conduction b) Convection c) Radiation d) Radiation and Convection	3	3	R
4	Multiple pass heat exchangers are used to a) Increase the rate of heat transfer b) Reduce pressure drop c) Increase pressure drop d) Reduce friction loss	4	4	R
5	Which of the following body reflects entire radiation incident on it	5	5	U

	a) Transparent b) Black c) Gray d) White			
Part- B				
Answer all questions. Each sub division carries 2 marks (5x4=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Bloom s Level
6a)	Define Fourier's Law of Heat Conduction	1	1	R
6b)	Define thermal conductivity of materials	1	1	R
7a)	Differentiate laminar and turbulent flow	2	2	U
7b)	Define Reynolds Number	2	2	R
8a)	Define Newton's law of convection	3	3	R
8b)	Define Prandtl Number	3	3	R
9a)	Classify heat Exchangers	4	4	U
9b)	Brief fouling in heat exchangers?	4	4	R
10a)	Define Radiation shield	5	5	R
10b)	Brief black body concept	5	5	R
PART-C				
Answer all questions, Choosing any one division from each question.				
(5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Bloom s Level
11 a	Derive Conduction Heat transfer through plain Slab.	1	1	Ap
OR				
11 b	The inner surface of a plane brick wall is at 60°C and	1	1	Ap

	the outer surface is at 35°C calculate the rate of heat transfer per m ² of the surface area of the wall, which is 220mm thick. The thermal conductivity of the brick is 0.51 W/m°C			
12 a	Air at atmospheric pressure and 40°C flows with a velocity of U=5m/s and over a length of 2m, 1m width flat plate whose surface is kept at a uniform temperature of 120°C.Determine 1)average heat transfer coefficient 2)heat transfer between the flat plate and air (take for air properties $\nu=2.107 \times 10^{-5} \text{ m}^2/\text{s}$, $K=0.03025\text{W/mK}$; $\text{pr}=0.6965$	2	2	Ap
OR				
12 b	Explain Thermal boundary layer in detail.	2	2	U
13 a	A vertical pipe of 0.12m outer diameter, 2.5m long at a surface temperature of 120°C is in a room where the air is at 20°C. Calculate the heat loss per meter length of the pipe.	3	3	Ap
OR				
13 b	Explain three regimes of boiling in detail.	3	3	U
14 a	The flow rates of hot and cold water streams running through a parallel flow Heat exchanger is 0.2 kg/s and 0.5 kg/s. The inlet temperature on hot and cold sides 75 °C and 20°C respectively. The exit temperature of hot water is 45°C. If the individual heat transfer coefficients on both sides are 650 W/m ² °C, Calculate the area of the heat exchanger.	4	4	Ap
OR				
14 b	Derive an expression for logarithmic mean	4	4	Ap

	temperature difference (LMTD) for parallel flow heat exchanger.			
15 a	Determine the radiant heat exchanger in W/m^2 between two large parallel plates of emissivity 0.8 and 0.5 held at temperatures of 1000K and 500K. If a thin copper plate of emissivity of 0.1 is introduced as a radiation shield between two plates. Use Stefan Boltzmann constant $\sigma = 5.67 \times 10^{-8} \text{ W/m}^2 \text{ K}^4$	5	5	Ap
OR				
15 b	Explain Absorption, Reflection and Transmittance of radiation.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be Implemented from the Academic Year 2022-2023 Onwards)**

Programme : Mechanical Engineering (R&AC)

Term : IV

Course Code : 2207

Course Name : Machining Processes

Number of periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
2207	Machining Processes	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total : 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Theory of Metal Cutting, Drilling & Boring	13	0	0	13
2	Turning	13	0	0	13
3	Milling and Gear Manufacturing	13	0	0	13
4	Grinding and Broaching	13	0	0	13
5	Non-Conventional Machining Processes	13	0	0	13
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Calculate the tool life and cutting parameters for various cutting tools (Unit 1)
2. Produce a functional component using drilling and boring machines (Unit 1)
3. Produce a functional component using lathe (Unit 2)
4. Produce a functional component using milling machine. (Unit 3)
5. Produce a functional component using forming and generating methods. (Unit 3)
6. Produce a functional component using grinding machine. (Unit 4)
7. Explain the various non conventional machining processes. (Unit 5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	THEORY OF METAL CUTTING, DRILLING & BORING	13	0	0
	1.1 : Theory of Metal Cutting Introduction - Methods of metal cutting - Orthogonal cutting-Oblique cutting - cutting tool nomenclature- Single point - types of chips - Chip formation- Chip Breakers- Cutting parameters- - Machinability. Cutting tool material -Carbide, HSS, Ceramics, Polycrystalline diamond (PCD), Cubic boron nitride (CBN),Cermets, Diamond-Properties- tool life calculation - ISO standard inserts-selection of inserts-Tool holders- Cutting fluids, metal cutting oils, synthetic fluids.	5	0	0
	1.2 :Drilling Drills - flat drills - twist drills – nomenclature of twist drill - Types of drilling machines- floor type, radial type, multi spindle type - speeds and feeds for various materials-methods of holding drill bit-drill chucks-socket and sleeve-drilling-operation-reaming- counter sinking-counter boring- spot facing- tapping-deep hole	5	0	0

	drilling.			
	1.3 : Boring Boring machines-horizontal and vertical types-fine boring machines-jig boring machine- boring tools	3	0	0
2	TURNING	13	0	0
	2.1 : Centre Lathe Theory of lathes – specifications – principal parts – head stock – all geared type – tumbler gear mechanism – apron mechanism – carriage- cross slide – automatic, longitudinal and cross feed mechanism – tail stock and its functions. Work holding devices – face plate – three jaw chuck – four jaw chuck – catch plate and carrier. Machining operations done on lathe - straight turning – step turning-taper turning-knurling- Thread cutting-Facing- Boring –chamfering. Cutting speed-feed-depth of cut-Simple problems	10	0	0
	2.2 : Semi Automatic Lathes Types of semi automatic lathes – capstan and turret lathes – difference between turret and capstan – turret indexing mechanism.	3	0	0
3	MILLING AND GEAR MANUFATURING	13	0	0
	3.1 : MILLING Types-Horizontal milling machine, vertical milling machine, universal milling machine- vertical milling attachment- principles of operation- Milling process - conventional milling- climb milling. Specification of milling machines-work holding devices-angle plate, vices, indexing head, fixtures. Tool holding devices-arbor-stub arbor-spring collets- adapter. Milling cutters-cylindrical milling cutter-slitting saw- side and face milling cutter-angle milling cutter-T slot milling cutter-woodruff milling cutter. Milling operations- Plain milling, End milling, Side and face milling, Form	8	0	0

	milling.			
	3.2 :Gear Manufacturing Types of gears – Gear forming method- milling- broaching -Gear generating method - Gear shaper, gear hobbing- principle of operation- gear finishing processes- burnishing, shaving, grinding and lapping- gear materials	5	0	0
	GRINDING AND BROACHING	13	0	0
4	4.1 : Grinding Types and classification-specifications-precision grinding - cylindrical grinder, center less grinders ,surface grinder - tool and cutter grinder - principles of operations-grinding wheels abrasives- natural and artificial -types of bonds-grit, grade and structure of wheels-wheel shapes and sizes-standard marking systems - selection of grinding wheel- Dressing and Truing of wheels-Balancing of grinding wheels.	8	0	0
	4.2 :Broaching Types of broaching machine-horizontal, vertical and continuous broaching-principles of operation-types of broaches-push broach, pull broach -broaching operations	5	0	0
	NON-CONVENTIONAL MACHINING PROCESSES	13	0	0
5	5.1 : Mechanical energy based Process Introduction - classification - process selection - limitations demerits of conventional processes. Mechanical energy based process: Introduction - abrasive jet machining - metal removal rate process parameters - water jet machining - ultrasonic machining process - advantages – disadvantages - applications.	4	0	0

	5.2 : Electrical Energy Based Processes 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.	5	0	0
	5.3 : Thermal energy based processes Introduction - electron beam machining - laser beam machining - machining applications of laser- plasma arc machining – gases used in plasma arc machining - advantages – disadvantages - applications.	4	0	0

TEXT BOOKS:

1. Hajra Choudhury & Bhattachary (11thEdition) ," Elements of Workshop Technology", published by Media Promoters and Publishers Pvt. Ltd.,
2. P.C .Sharma, "A text book of Production Technology (Manufacturing Processes)", S.Chand & Co.Ltd.,2007

REFERENCE BOOKS:

1. Jain & Gupta, "Production Technology", Khanna Publishers, 2006.
2. Serope kalpakjian & Steven R.Schmid (14th Edition),"Manufacturing engineering and technology".
3. Myron Begman (5th Edition), "Manufacturing process", Tata McGraw Hill Publishing Co Ltd .,

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time : 3 Hrs

Max. Marks : 75

Pattern of the Question Paper :

PART A - 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B - 5 Questions with two subdivisions taken from each unit. Each question carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	5	50
TOTAL				75

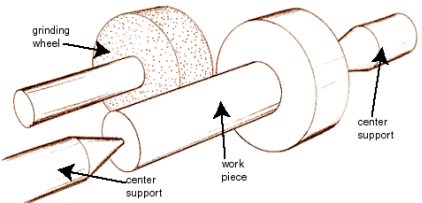
MODEL QUESTION PAPER

Course Code & Course Name : 2207 - Machining Processes

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Question			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	In reaming process a) Metal removal rate is high b) High surface finish is obtained c) High form accuracy is obtained d) High dimensional accuracy is obtained	2	1	U
2	For right hand thread cutting, the tool move towards a) head stock end b) the center c) tailstock end d) back of the bed	3	2	U
3	The process of removing metal by a cutter which is rotated against the direction of travel of work piece is called a) up milling b) Down milling c) face milling d) End milling	4	3	U
4	In order to grind soft material a) fine grained grinding wheel is used b) medium grained grinding wheel is used c) very fine grained grinding wheel is used d) coarse grained grinding wheel is used	6	4	R
5	The metal removed from the work piece surface due	7	5	U

	to spark erosion is the process of			
	a) chemical milling			
	b) electric discharge machining			
	c) electro chemical machining			
	d) laser beam machining			
Part- B				
Answer all questions: Each sub division carries 2 mark				
(10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6 a)	Write the difference between orthogonal cutting and oblique cutting.	1	1	U
6 b)	Find the time for drilling a 18 mm diameter hole in 30mm M.S. plate at a speed of 300rpm and a feed of 0.2 mm per revolution.	2	1	Ap
7 a)	Name the various methods for taper turning operation.	3	2	R
7 b)	A rod of 30mm diameter is turned at a cutting speed of 25m/mt. Find the r.p.m of the rod.	3	2	Ap
8 a)	Write any two specifications of milling machine.	4	3	R
8 b)	What is gear lapping?	5	3	U
9 a)	. Identify the type of grinding operation shown below. 	6	4	U
9 b)	Difference between pull broach and push broach.	5	4	U
10 a)	List the purpose of non conventional machining?	7	5	R

10 b)	What is the function of servo mechanism in EDM?	7	5	U
PART-C				
Answer all questions, choosing any one division from each question.				
(5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a)	Explain nomenclature of twist drill with neat sketch.	2	1	U
OR				
11 b)	List out the difference operations done on a drilling machine. Explain with neat sketch any four operations.	2	1	U
12 a)	Explain in detail about tumbler gear mechanism with a neat sketch.	3	2	U
OR				
12 b)	Name the work holding devices used in a lathe. Explain with neat sketch any two device.	3	2	U
13 a)	Describe the construction and working of plain milling machine with neat sketch.	4	3	U
OR				
13 b)	Explain the principle of operation of gear shaper with neat sketch.	5	3	U
14a)	Explain the horizontal spindle – reciprocating table surface grinder with neat sketch	6	4	U
OR				
14 b)	Explain construction and working of a horizontal broaching machine.	6	4	U
15 a)	Explain the working principles of ultrasonic machining with neat sketch. State its advantages and	7	5	U

	disadvantages.			
OR				
15b)	Explain the plasma arc machining with neat sketch. State its application, advantages and disadvantages.	7	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : IV
Course Title : 2204
Course Code : Electrical and Electronics Engineering
Number of Periods per week : 5
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Durati on Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
2204	Electrical and Electronics Engineering	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total : 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Electric circuits and magnetic circuits	12	0	0	12
2	Dc machines and transformer	14	0	0	14
3	Ac machines and electrical safety	13	0	0	13
4	Electronics	14	0	0	14
5	Logic gates and PLC	12	0	0	12
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Solve problems using relationship between quantities in electric and Magnetic circuits. (Unit 1)
2. Apply the concepts of magnetism and electromagnetism in electrical machines with real world applications. (Unit 2)
3. Use electrical energy saving techniques and electrical safety equipments. (Unit 3)
4. Explain the electronic circuits by applying the principles of electronic devices. (Unit 4)
5. Develop the ladder logic for various process using PLC and logic gates. (Unit 5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	ELECTRIC CIRCUITS AND MAGNETIC CIRCUITS	12	0	0
	1.1 DC Circuits : Electrical Quantities – Definition and units of Electric charge, current, voltage, and resistance – Ohm’s Law and Kirchoff’s laws – Resistance in series, parallel and series parallel – Simple problems.	4	0	0
	1.2 Magnetic Circuits: Electromagnetism (Definitions only), Magnetic flux, Flux density, Magnetic field intensity, MMF, permeability, reluctance, Faraday’s laws of electro-magnetic induction - Simple problems.	4	0	0
	1.3 AC Circuits: Fundamentals of AC voltage and current – Peak, average, RMS value of sine wave, Frequency, Time period, Amplitude, Power, Power factor (Definition only). 3 phase system – advantages over single phase system - Relation between line and phase values in star and Delta systems (No derivations) – Simple problems.	4	0	0

2	DC MACHINES AND TRANSFORMER	14	0	0
	DC generator - Working principle – Construction – Types –Applications. DC motor –Working principle – construction – Types. Speed control - armature and field control method , Applications. Starter- Necessity-working principle of 3 point and 4 point starter. Transformer – introduction –principle of operation-construction (core and shell type) - types, EMF equation, autotransformer- Losses and Efficiency.	14	0	0
3	AC MACHINES AND ELECTRICAL SAFETY	13	0	0
	3.1 Alternators Basic principle – Construction–types- applications. AC motors - Principle of operation of single phase capacitor start induction motor – Three phase induction motors – Types-construction and working of SQ cage and slip ring IM– Applications. Starter- Necessity- working principle of DOL and Star delta starter. PMDC, Stepper motor –construction and working, applications.	8	0	0
	3.2 Electrical safety: Fuse-Necessity-selection-types. Circuit breakers- Necessity-MCB, MCCB and ELCB. Earthing-Importance, types-difference between earth and neutral. Electrical Accident-causes and precautions. Energy conservation-calculation of energy usage in small area and energy cost –importance of star rating.	5	0	0
4	ELECTRONICS	14	0	0
	4.1 Semiconductor materials N type and P type – PN junction – Forward and Reverse bias with VI characteristics.	4	0	0
	4.1 Rectifiers Half wave, Full wave and Bridge rectifier. Transistor – symbol - types –operation of transistor as a switch and an amplifier with example. Thyristors – Principle and	10	0	0

	working of SCR – Characteristics – Applications Regulated power supply – Block diagram – working of UPS, SMPS. Special semiconductor-Introduction- working of LED, LCD, Solar cell-Photo voltaic and photo conductive cell.			
5	LOGIC GATES AND PLC	12	0	0
	5.1 LOGIC GATES - Positive and negative logic, definition, symbol, truth table, Boolean expression for OR, AND, NOT, NAND, EXOR and EXNOR gates.	5	0	0
	5.2 PLC PLC definition –Features and benefits - Block diagram - PLC circuit verses hard wired circuits – types of contacts– ladder logic symbol – AND logic, OR logic and NOT logic – Truth table –Timer, counter -PLC scan - Steps involved in application circuits using a PLC	7	0	0

TEXT BOOKS:

1. V.K.Metha,Rohitmetha, "Principles of Electrical and electronics Engg", Multicolor illustrative edition- ,S. Chand Corp (2005),
2. PETRUZELLA D FRANK, "Programmable logic controller", Tata McGraw-Hill Education (2010).

REFERENCE BOOKS:

1. BL. Theraja," Fundamentals of Electrical Engg", S. Chand Corp (1996).
2. BHATTACHARYA S K, BRIJINDER SINGH "Control of electrical machines", New Age International (P) Limited Publishers (2003),.
3. JOHN W WEBB; Ronald A Reis), "Programmable logic controller principles and applications "(2003.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

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PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

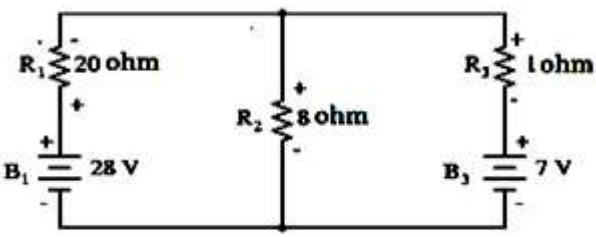
Course Code & Course Title : 2204 - ELECTRICAL AND ELECTRONICS
ENGINEERING

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions			(5X1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	Determine the current through the resistor if $V = 10\text{ V}$ and $R = 100\text{ ohm}$. a) 20 mA. b) 10 mA. c) 0.1 A d) 1 A.	1	1	Ap
2	Commutators in DC machines have a role of which converts a) AC to DC. b) high voltage DC to low voltage DC. c) Both AC to DC and DC to AC. d) DC to AC.	2	2	R
3	There is no electrical connection between stator and rotor still power is transferred from stator to rotor through a) magnetic flux b) air c) water d) magnet	3	3	U
4	Rectifier converts a) AC in to DC b) DC in to DC c) AC in to AC d) DC in to AC	4	4	R
5	PLC means a) Programmable Level controller b) Programmable logic controller c) Process level controller d) Process logic corrector	5	5	R

Part- B				
Answer all questions. Each subdivision carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No	Unit No.	Blooms Level
6 a)	State equivalent resistance or total resistance, If three resistance of same value are connected in series.	1	1	U
6 b)	Mention any two advantages of three phase system over single phase system.	1	1	U
7 a)	Mention the necessity of starter in DC motors.	2	2	R
7 b)	Brief step up and step down transformer?	2	2	R
8 a)	Explain the necessity of starter used in AC Motor	3	3	R
8 b)	Mention the difference between earth and neutral.	3	3	R
9 a)	Draw the VI characteristics of PN junction diode	4	4	U
9 b)	Compare Online and OFF-line UPS	4	4	U
10 a)	Draw the symbol and write the Boolean equation for EXOR logic gate.	5	5	U
10 b)	Define PLC	5	5	R
Part- C				
Answer all questions, choosing any one Question division from each division (5x10=50 Marks)				
Q. No	Question	CO No.	Unit No.	Blooms Level
11 a)	The three resistances of 15 ohms each and one 26 ohm resistance connected in parallel. This combination is connected in series with the 4 ohm resistance. A DC supply of 140V is applied at the ends of the complete circuit. Calculate total resistance, total current and power dissipated in each resistance.	1	1	Ap
OR				

11 b)	Find the current flowing through 8 ohm resistor 	1	1	Ap
12 a)	Explain the construction and working of four point starter with neat diagram.	2	2	U
OR				
12 b)	i) Explain the principle of operation of transformer with diagram. ii) Derive the emf equation of transformer	2	2	U
13 a)	Explain the construction and working of single capacitor start induction motor	3	3	U
OR				
13 b)	i) Explain the causes for an electrical accident. ii) Mention any five importance of star ratings.	3	3	U
14 a)	Explain the forward and reverse bias of PN junction diode with its VI characteristics.	4	4	U
OR				
14 b)	Draw and explain the operation of SMPS	4	4	U
15 a)	Draw the symbol, truth table and Boolean equation for NAND ,NOR and NOT logic gates	5	5	U
OR				
15 b)	i) Draw the block diagram of PLC and explain its parts ii) Explain the PLC scanning process	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering
Term : IV
Course Title : Heat Transfer Practical (R&AC)
Course Code : 9304
Number of Periods per week : 4
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9304	Heat Transfer Practical	3	25	75	100

COURSE OUTCOMES:

At the end of the course, the student will be able to

1. Calculate heat transfer through various mediums by conduction, Convection and Radiation.
2. Calculate effectiveness of parallel and counter flow heat exchangers.

9304-HEAT TRANSFER PRACTICAL

LIST OF EXPERIMENTS

1. Determine heat transfer through Composite Walls.
2. Determine Thermal conductivity of given Insulating Powder using concentric cylinder.
3. Determine Thermal conductivity of given Insulating Powder using concentric sphere.

4. Calculate Heat transfer rate by free convection.
5. Calculate Heat transfer rate through Pin- Fin apparatus by natural convection.
6. Calculate Heat transfer rate by Forced convection.
7. Calculate Heat transfer rate through Pin- Fin apparatus by forced convection.
8. Determine Heat transfer rate and Effectiveness of Parallel flow Heat Exchanger.
9. Determine Heat transfer rate and Effectiveness of Counter flow Heat Exchanger.
10. Determine Stefan Boltzmann constant of the Concentric Hemisphere.
11. Determine emissivity of given test plate.

SCHEME OF EVALUATION FOR END TERM EXAMINATION

SI. NO.	CONTENTS	MARKS ALLOTTED
1	Formula & Tabulation	15
2	Observation (Readings) & Procedure	20
3	Calculation/Graph	30
4	Result	5
5	Viva Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)
Term : IV
Course Code : 9205
Course Title : Manufacturing Technology Practical
Number of Periods per week : 4
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9205	Manufacturing Technology Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to,

1. Prepare green sand moulds for solid and split patterns
2. Create different types of arc welded joints for the given mild steel flat plates
3. Machine the component using lathe.
4. Machine a component using different machine tools.

9205 – MANUFACTURING TECHNOLOGY PRACTICAL

LIST OF EXPERIMENTS:

I. Foundry Practices:

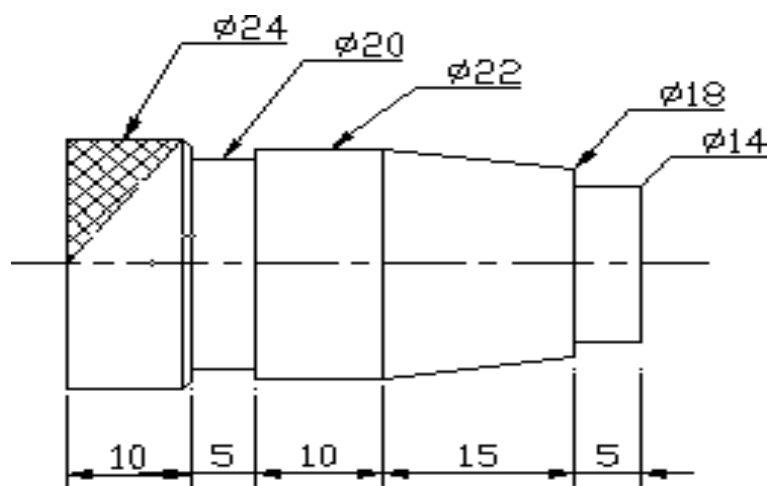
1. Prepare the mould for solid Pattern - Cube.
2. Prepare the mould for split pattern -Dumbbells.
3. Prepare the mould for split Pattern- T pipe.

II. Welding Exercises:

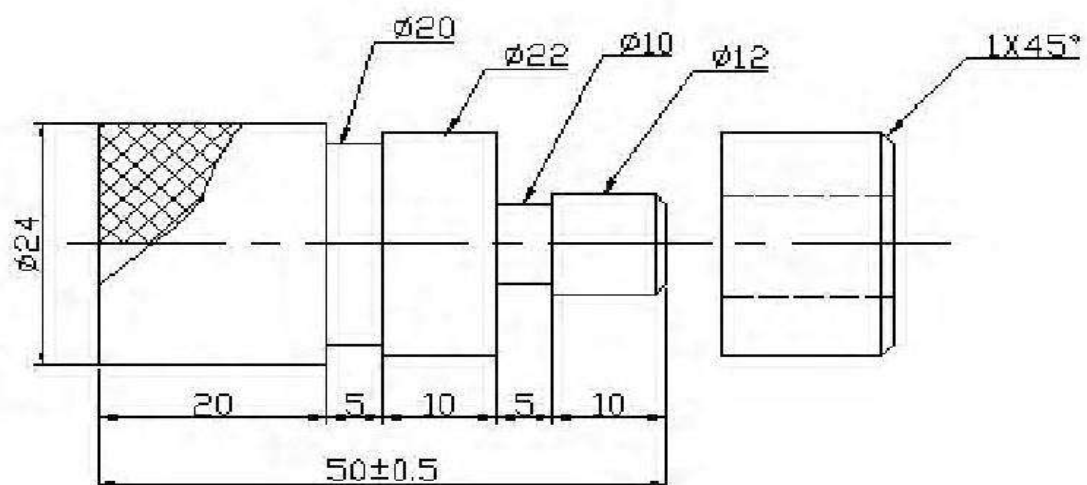
4. Create an arc welded butt joint for M.S flat plate.
5. Create an arc welded lap joint for M.S flat plate.
6. Create an arc welded T- joint for M.S flat plate.

III. Lathe Exercises:

7. Machining of step with taper turning in a mild steel rod for the given dimensions and measure the component using appropriate measuring instrument.

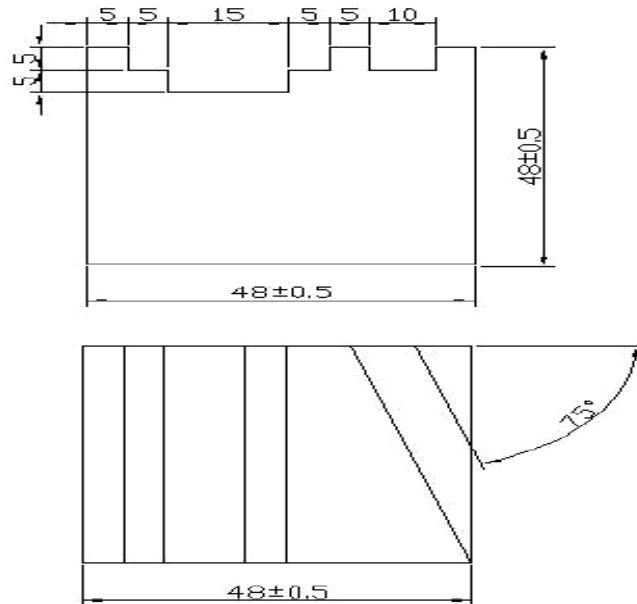


8. Machining of Pin & bush in capstan lathe of a mild steel rod for the given dimensions and measure the component using appropriate measuring instrument.

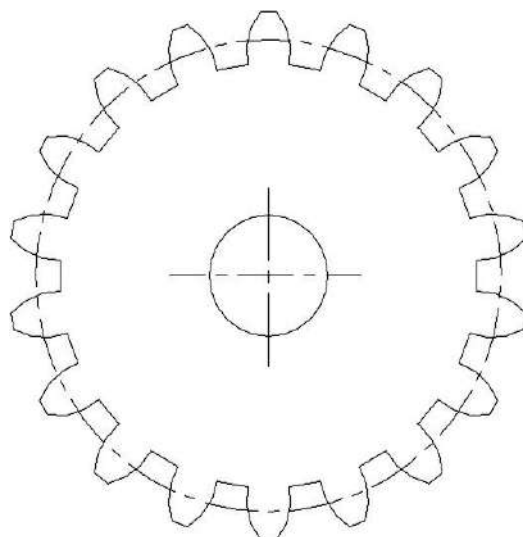


IV. Special Machines Exercises:

9. Step milling in milling machine of cube for the dimensions mentioned in drawing and measure the component using appropriate measuring instrument.

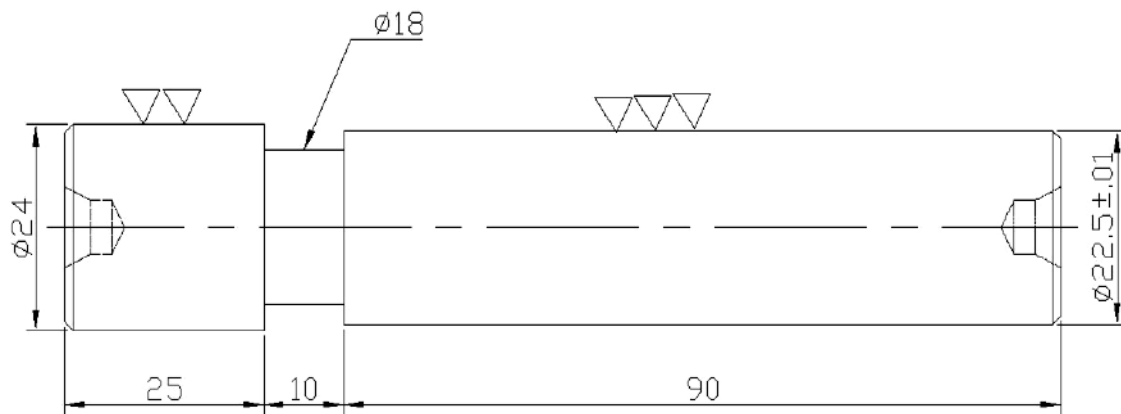


10. Machining of spur gear in milling machine for the dimensions mentioned in drawing and measure the component using appropriate measuring instrument.



No. of teeth = 31
Module = 3

11. Cylindrical grinding of shaft in cylindrical grinding machine for the given dimensions and measure the component using appropriate measuring instrument.



Scheme of Examination:

S.NO	CONTEN TS		MARKS ALLOTTED
1	Foundry	Preparation of sand	10
		Ramming & vent holes	15
		Gate cutting / Finishing	10
2	Or		
	Welding	Handling of tools	10
		Weld bead & finishing	25
3	And		
	Lathe / Special Machines	Job preparation / Marking	15
		Setting / Operations	35
		Dimensions / Surface finish	20
4	Viva Voce		5
TOTAL			75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 Onwards)

Programme : Mechanical Engineering (R&AC)
Term : IV
Course Code : 9206
Course Title : Electrical and Electronics Engineering Practical
Number of Periods per week :4
Total Number of weeks per term :16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9206	Electrical And Electronics Engineering Practical	3	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to,

1. Determine the performance characteristics of electrical machines.
2. Develop the electronic circuit using appropriate electronic devices for given application

9206 - ELECTRICAL AND ELECTRONICS ENGINEERING PRACTICAL

Electrical Engineering

1. Measure single phase power using three ammeters and one voltmeter.
2. Measure single phase power using three voltmeters and one ammeter.
3. Perform Load test on DC shunt motor.
4. Perform Load test on single phase transformer.
5. Perform Load test on single phase induction motor.

6. Determine energy utilization and cost of energy in a given load area.

Electronics Engineering

1. Plot the VI characteristics of PN junction diode.
2. Design a half wave and determine the ripple factor and load regulation
3. Design a full wave and determine the ripple factor and load regulation
4. Construct the Regulated power supply using IC 7805 and also calculate load and line regulation.
5. Prove the given Boolean Expression using Logic gates.

SCHEME OF EXAMINATION:

SI NO	CONTENTS	MARKS ALLOTTED
1	Circuit diagram	25
2	Connection	25
3	Procedure and result	20
4	Viva - Voce	05
	TOTAL	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : IV

Course Code : 9207

Course Title : Machine Drawing Practical

Number of Periods per week : 5

Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9207	Machine Drawing Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Draw the sectional views of the parts and assembly of machine components.

9207- Machine Drawing Practical

IV-Term

LIST OF EXERCISES

Detailed drawings of following machine parts are given to students to assemble and draw the sectional or plain elevations / plans / and side views with dimensioning and bill of materials

1. Sleeve & Cotter joint
2. Gib and Cotter joint

3. Knuckle joint
4. Screw Jack
5. Universal Coupling
6. Foot step bearing
7. Plummer Block
8. Machine Vice
9. Flange coupling – protected type
10. Connecting Rod

SCHEME OF EVALUATION FOR END TERM EXAMINATION

S. NO	CONTENTS	MARKS ALLOTTED
I	Front view	35
2	Top view/ side view	25
3	Bill of materials	10
III	Viva- Voce	05
	TOTAL	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : IV
Course Code : PS04
Course Title : Professional Skills (Ethical and Moral Responsibility)
Number of Periods per week : 1
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I+E)
PS04	Professional Skills (Ethical and Moral Responsibility)	-	-	-	-

TOPICS AND ALLOCATION OF PERIODS**L - T - P : 1 - 0 - 0 Periods / Week****Total : 16 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Ethical practices – importance	4	0	0	4
2	Ethical practices – fundamentals	3	0	0	3
3	Codes of conduct	3	0	0	3
4	Professional practices at work	3	0	0	3
Evaluation					3
Total					16

COURSE OUTCOMES

At the end of the course, the student will be able to,

1. Articulate the importance of ethical and moral responsibilities
2. Explain the fundamental aspects of ethical practices
3. Validate one's appropriate and inappropriate behaviours in various roles
4. Elaborate code of conduct of professional bodies
5. Explain the importance of professional practices as a future employee/ entrepreneur

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	ETHICAL PRACTICES – IMPORTANCE	4	0	0
	Why ethical practices; The current day scenario of ethical practices – parents, society, politics & business; Awareness of skewedness of information – news, advertisements and other media; The need for ethical and moral responsibility on a personal level; Handling oneself amidst peer pressure and societal pressure;	4	0	0
2	ETHICAL PRACTICES – FUNDAMENTALS	3	0	0
	Morality & Ethics; Moral issues, inquiry, moral dilemmas; Moral autonomy – Kohlberg's theory and Gilligan's refinement; Theories on "right action" – virtue ethics, utilitarianism, duty ethics, rights ethics – resolving moral dilemmas; justifying moral obligations;	3	0	0
3	CODES OF CONDUCT	3	0	0
	Importance of code of conduct and its role; Evolving draft Code of conduct for different roles – son/daughter, student, future employee & citizen; Reflection on real time incidences at the college. Engineers as responsible experimenters; Faith of the Engineer (ABET); Pledge and Code of ethics as per National Society of Professional Engineers (NSPE);	3	0	0

	Code of Ethics of Institution of Engineers (India); Case studies and discussions in professional context			
	PROFESSIONAL PRACTICES AT WORK	3	0	0
4	Transition from a student to a professional; Importance of professional practices at work; Integrity as the topmost virtue of a professional; Self-awareness: Where competence ends and professionalism takes over; Professional qualities; Need to align oneself to culture & values of organizations; Need to embrace diversity in organizations.	3	0	0

At least one lecture by senior people from Industries / Government organizations / reputed institutions to be conducted.

Course handouts (compiled by PS team)

1. Learner's workbook
2. Learner's logbook (journal)
3. Reading material

References:

1. Mike W Martin & Roland Schinzenger, Ethics in Engineering, Tata McGraw-Hill Education Pvt. Ltd, Third Edition.
2. Code of conduct document, MCET student handbook
3. Gail D Baura, Engineering Ethics - an industrial perspective, Academic Press, Elsevier, 2006.
4. Subrato Bagchi, The professional - Defining the new standard of Excellence at work, Penguin India, 2011.

Tests and Grading

Sl. No.	Evaluation	Criterion	Total marks	
1	Course Evaluation	Comprehensive Examination and Viva voce	KT* & SKT*, Short questions	20 marks
			Viva voce	05 marks
			Total	25 marks

*KT = Knowledge Test, SKT = Scenario based Knowledge Test

Grade

- 1) Marks between 25 to 20 – Excellent
- 2) Marks between 19 to 15 – very good
- 3) Marks between 14 to 10 good
- 4) Marks below 10 satisfactory

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9305

Course Title : Refrigeration

Number of Periods per week : 6

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9305	Refrigeration	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 6-0-0 Periods / Week****Total: 96 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Introduction to Refrigeration and Vapour Absorption Cycle	16	0	0	16
2	Vapour Compression System	16	0	0	16
3	Refrigerants and Instrumentation	16	0	0	16
4	Production of Low Temperature Refrigeration	15	0	0	15

5	Other Refrigeration System and Methods of Defrosting	15	0	0	15
Continuous Assessment Tests, Class Assignments and Revision					18
Total					96

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Explain the principles of refrigeration and vapour absorption system(UNIT-1)
2. Calculate the COP of vapour compression System(UNIT-2)
3. Select Refrigerants and instruments used in Refrigeration systems(UNIT-3)
4. Explain the production of low temperature systems(UNIT-4)
5. Explain the non-conventional refrigeration systems and defrosting methods(UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	INTRODUCTION TO REFRIGERATION	16	0	0
	1.1 Introduction to Refrigeration Definition of Refrigeration -- Refrigeration Effect - C.O.P - Unit of refrigeration –Engine- heat supplied, heat rejected, work output, thermal efficiency, Refrigerator-thermal efficiency,-heat absorbed, heat rejected, relative COP, work input, COP, Heat pump-heat absorbed, heat delivered, work input, EPR, No derivation – Simple problems. Reversed Carnot cycle – ‘Bell Coleman’ cycle – C.O.P. derivation – Simple problems to find COP	10	0	0

	1.2 Vapour Absorption Cycle Practical Ammonia absorption system – Lithium – Bromide System – Electrolux System – No derivation – No problems.	6	0	0
2	VAPOUR COMPRESSION SYSTEM	16	0	0
	Mechanism of Simple Vapour compression system – P-H and T-S Diagram – Presentation of different processes on P-H and T-S diagram – Wet Versus Dry Compression – Effect of sub cooling of liquid - Effect of super heating of Vapour – Effect of varying suction pressure – Effect of varying discharge pressure – Actual Vapour Compression cycle – Advantages and Disadvantages of Vapour compression over Air - refrigeration system – comparison of vapour compression and absorption system – Problems on C.O.P - Capacity of the plant – power required for theoretical simple Vapour compression cycle by using refrigerant tables and charts			
3	REFRIGERANTS& INSTRUMENTATION	16	0	0
	3.1 Refrigerants Definition – desirable properties of an ideal refrigerant – Classification of refrigerant – halocarbon refrigerants–Azeotrope refrigerants - inorganic refrigerants- Hydro carbon refrigerants – Designation - system of refrigerants ---substitutes for CFC- comparison of refrigerants- thermodynamic, chemical and physical properties - study of important refrigerants- ammonia, carbon-di-oxide,R12, R22, R134a, R407C, R410a, R32– secondary refrigerants - Natural refrigerants - hydrocarbons – Refrigerant lubricants - Leak detection.	9	0	0

	3.2 Instrumentation Measurement of pressure – Bourdon tube gauge – simple U- Tube manometer – Differential U-tube manometer – Differential Pressure transducer- Temperature measurement – Thermocouples – mercury thermometer – Gas filled Thermometer – Flow measurement – Rota meter – Digital meter.	7	0	0
4	PRODUCTION OF LOW TEMPERATURE REFRIGERATION	15	0	0
	Limitation of vapour compression system for the production of Low temperature – Two stage cascade system – Solid CO ₂ – Production of solid CO ₂ by vapour compression system – Joule Thomson effect and liquefaction of gases (Definition only) - Liquefaction of Hydrogen – Liquefaction of helium – Linde system only– Liquefaction of Air – Linde and Claude system –Applications of low temperature-material properties -Super conductivity- Super Fluidity-expansion fitting - Cryobiology – preservation of biological materials –space propulsion, super insulation, No problems.			
5	OTHER REFRIGERATION SYSTEM AND METHODS OF DEFROSTING	15	0	0
	5.1 Other Refrigeration System : See back effect – Peltier effect – Thomson effect – Thermoelectric refrigeration system - Required properties of thermoelectric materials in terms of electrical conductivity, thermal conductivity and rate of change of voltage with temperature-Solar refrigeration. Steam jet refrigeration-construction and working- No derivation – No problems	9	0	0

	5.2 Methods Of Defrosting: Necessity for defrosting – Manual defrosting – Pressure control defrosting – Temperature control defrosting – Water defrosting – Reverse cycle defrosting – Automatic defrosting – Electric defrosting.	6	0	0
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TEXT BOOKS:

1. R.S. Khurmi and J.K. Gupta, "A text book of Refrigeration and Air- conditioning", S.Chand publications, 2019.
2. Arora and Domkundwar, "A course in Refrigeration and Air-conditioning by DhanpatRai& Co. ltd, 2018.
3. Manohar Prasad, "Refrigeration & Air Conditioning", New Age International (P) Ltd, 2021.

REFERENCE BOOKS:

1. C.P.Arora, "Refrigeration and Air-conditioning", TaTaMcGraw Hill Educaion, 2021.
2. ROY J.Dossat, "Principles of Refrigeration", Person Education Publication, 2002.
3. R.K.Rajput, "A text book of Refrigeration and Air-conditioning", S.K. Kataria& Sons, 2013.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

6b	Define relative COP.	1	1	R
7a	Brief sub-cooling in Vapour compression system?	2	2	R
7b	Differentiate vapour compression with vapour absorption system.	2	2	U
8a	With an example, state primary refrigerant	3	3	R
8b	State the use of thermocouples	3	3	R
9a	Define cascade system	4	4	R
9b	Brief super insulation	4	4	R
10a	Define See back effect	5	5	R
10b	State Peltier effect.	5	5	R

PART-C

Answer all questions, choosing any one division from each Question

(5x10 = 50 Marks)

Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	A refrigerating system working on Bell – Coleman cycle receives air from cold chamber at - 5°C and compress it from 1 bar to 6 bar. The compressed air is then cooled to a temperature of 37°C before it's expanded in the expander. Calculate the C.O.P of the system when the compression and expansion follows the law $PV^{1.25} = C$.	1	1	Ap
OR				
11b	With a neat sketch explain the construction and working of aqua –ammonia absorption system of refrigeration.	1	1	U
12a	With a neat Ph diagram explain the effect of varying the suction and discharge pressure in a	2	2	U

	VCS (vapour compression system).																						
OR																							
12b	A vapour compression refrigerator uses R-12 as refrigerant and the liquid evaporates in the evaporator at -15°C. The temperature of this refrigerant at the delivery from the compressor is 15°C when the vapour is condensed at 10°C. Find the coefficient of performance if i) there is no under cooling ii) the liquid is cooled by 5°C before expansion by throttling. Take specific heat at constant pressure for the superheated vapour as 0.64 KJ/KgK and that for liquid as 0.94 KJ/KgK. The other properties of refrigerant are as follows: <table border="1"> <thead> <tr> <th rowspan="2">temperature in ($^{\circ}\text{C}$)</th><th colspan="2">Enthalpy (kJ/kg)</th><th colspan="2">Entropy (kJ/kgK)</th></tr> <tr> <th>Liquid</th><th>Vapour</th><th>Liquid</th><th>Vapour</th></tr> </thead> <tbody> <tr> <td>-15</td><td>22.3</td><td>180.88</td><td>0.0904</td><td>0.7051</td></tr> <tr> <td>10</td><td>45.4</td><td>191.76</td><td>0.1750</td><td>0.6921</td></tr> </tbody> </table>	temperature in ($^{\circ}\text{C}$)	Enthalpy (kJ/kg)		Entropy (kJ/kgK)		Liquid	Vapour	Liquid	Vapour	-15	22.3	180.88	0.0904	0.7051	10	45.4	191.76	0.1750	0.6921	2	2	Ap
temperature in ($^{\circ}\text{C}$)	Enthalpy (kJ/kg)		Entropy (kJ/kgK)																				
	Liquid	Vapour	Liquid	Vapour																			
-15	22.3	180.88	0.0904	0.7051																			
10	45.4	191.76	0.1750	0.6921																			
13a	Discuss about halo carbon components and physical properties of refrigerants.	3	3	U																			
OR																							
13b	Explain the gas filled thermometer its a neat sketch.	3	3	U																			
14a	Sketch and explain the two stage cascade system.	4	4	U																			
OR																							
14b	Explain the working of Linde system for liquefaction of helium using a line sketch.	4	4	U																			
15a	Explain the working of thermo electric refrigeration system with a neat sketch.	5	5	U																			
OR																							

15b	Explain about electric defrosting with a neat sketch	5	5	U
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Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9306

Course Title : Air-Conditioning

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9306	Air-Conditioning	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Psychrometry	15	0	0	15
2	Psychrometric Processes	14	0	0	14
3	Humidifiers, Dehumidifiers and Air Distribution Systems	12	0	0	12
4	Indoor Air Quality	12	0	0	12
5	Air-Conditioning Systems	12	0	0	12
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Solve psychometric properties using tables and psychometric chart (UNIT-1)
2. Solve outlet condition of air for various psychometric processes (UNIT-2)
3. Explain Humidifier, Dehumidifier and Air distribution systems (UNIT-3)
4. Explain indoor air quality (UNIT-4)
5. Explain various types of Air-Conditioning systems (UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	PSYCHROMETRY	15	0	0
	Psychrometry – Definition – Properties of psychometric – dry air - Moist air- water vapour- specific humidity - Absolute humidity - Relative humidity -Degree of saturation -DBT – WBT – DPT- sensible heat of air - Humid specific Volume – Total heat of air-sensible heat of air, latent heat of water vapour, enthalpy of moist air. Dalton's law of partial pressure to moist air- relationship between Humidity ratio - Important psychrometric relations(No derivation)- degree of saturation - Relative humidity –pressure of water vapour-enthalpy of moist air – (No Derivation)-Simple problems – Calculation of air properties –using equations- Sling psychrometer – laboratory psychrometer - aspirating psychrometer.			
2	PSYCHROMETRY PROCESSES	14	0	0
	Psychrometric chart – representation of psychrometric properties- Psychrometric processes – sensible heating - Sensible cooling – Sensible heat factor - Bypass factor – Humidification – Dehumidification – Cooling with -			

	dehumidification- Cooling with adiabatic humidification - adiabatic chemical dehumidification – Heating and humidification – adiabatic mixing of air stream –description only-no derivation-simple problems.			
	HUMIDIFIERS, DEHUMIDIFIERS AND AIR DISTRIBUTION SYSTEMS	12	0	0
3	3.1 Humidifiers, Dehumidifiers: Humidification, humidifier by steam injection – steam injection type and electric steam generator. By atomizing the coater – Atomization type, impact type, hydraulic separation type, mechanical separation. By evaporating the water – pan & coil type, Heated Water type heated air type by air washing – spray type air washer humidifier. (No problems and no derivations) Dehumidification – by reducing air temperature below DPT, spray type dehumidifier. No problems and no derivations	6	0	0
	3.2 Air distribution system: Air distribution system: air distribution system for theatre and Auditorium - Upward air distribution – Overhead air distribution - Ejector distribution system-Duct Arrangement systems -perimeter system - perimeter loop system - Radial perimeter system – Extended volume system – Single duct system – Dual duct system.	6	0	0
	INDOOR AIR QUALITY	12	0	0
4	Requirement of comfort Air conditioning – Physiological hazards resulting from heat – Factors affecting human comfort - optimum effective temperature –			

	Heat production and regulation in human body – Heat and moisture losses from the human body – Moisture content of air – Quality and Quantity of air Environmental impacts due to CFC and HFC refrigerants- International protocols for Ozone depletion and global warming potential– Air motion – Cold and Hot surfaces – Air stratification - factors governing optimum effective temperature.			
	AIRCONDITIONING SYSTEMS	12	0	0
5	Classification of air conditioning system – factors affecting comfort Air Conditioning-equipments used in an Air Conditioning system-comfort air conditioning system – Industrial air conditioning system – Winter air conditioning system – Summer air conditioning system – year round air conditioning system – unitary air conditioning system – Window air conditioner –split air conditioner - packaged air conditioner – Central air conditioning system –chiller plant-VRF Systems-Clean Room-Green Building-Solar Air Conditioning-Selection of AC system-Description only-no problems			

TEXT BOOKS:

1. R.S. Khurmi and J.K. Gupta, “A text book of Refrigeration and Air-conditioning”, S.Chand publications, 2019.
2. Arora and Domkundwar, “A course in Refrigeration and Air-conditioning by Dhanpat Rai & Co. Ltd, 2018.
3. Manohar Prasad, “Refrigeration & Air Conditioning”, New Age International (P) Ltd, 2021.

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- 1.. C.P.Arora, “Refrigeration and Air-conditioning”, TaTaMcGraw Hill Educaion, 2021.

2. ROY J.Dossat, "Principles of Refrigeration", Person Education Publication, 2002.
3. R.K.Rajput, "A text book of Refrigeration and Air-conditioning", S.K. Kataria& Sons, 2013.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A - 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B - 5 Questions with two subdivisions taken from each unit. Each question carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9306 - AIR-CONDITIONING**Time: 3 Hrs**

Marks: 75

Part- A				
Objective Questions: Answer all Questions (5x1= 5 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	A mixture of dry air and water vapor, when the air has diffused the maximum amount of Water vapor into it is called a) Dry air b) Moist air c) Saturated air d) Specific humidity	1	1	U
2	During sensible cooling of air, the specific humidity a) increases b) decreases c) remains constant d)increases then decreases	2	2	R
3	A duct is said to be a low velocity duct, if the velocity of air in the duct is up to a) 600 m/min b) 800 m/min c) 1200 m/min d) 1600m/min	3	3	R
4	The human body gets comfortable when the heat stored in the body is a) Positive b) negative c) Zero d) Positive or negative	4	4	R

5	In summer, air is a) cooled and humidified b) cooled and dehumidified c) heated and humidified d) heated and de humidified	5	5	U
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Part- B

Answer all questions. Each sub division carries 2 marks (5x4=20 Marks)

Q. No.	Question	CO No.	Unit No.	Blooms Level
6a)	Define Specific humidity	1	1	R
6b)	Define Dalton's Law of partial pressure.	1	1	R
7a)	Differentiate sensible heating and sensible cooling process.	2	2	U
7b)	Differentiate humidification and dehumidification process.	2	2	U
8a)	Define Atomization type humidification process?	3	3	R
8b)	Sketch of perimeter system of duct arrangement.	3	3	R
9a)	Define Optimum effective Temperature	4	4	R
9b)	State air stratification	4	4	R
10a)	Classify Air-Conditioning system based on season.	5	5	U
10b)	State the components used in an air conditioning system	5	5	R

PART-C				
Answer all questions, Choosing any one division from each question.				
(5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11 a	How the dry bulb and wet bulb temperature is measured using Sling Psychrometer? Explain with sketch.	1	1	U
OR				
11 b	The atmospheric conditions of Air are 25°C and Specific humidity=0.0086 kg per kg of dry air. Take Barometer reading as 1.01325 bar. Determine i) Saturation pressure of Vapor ii) Dew point Temperature iii) Relative humidity	1	1	Ap
12 a	Explain Heating with Humidification process with aid of Psychrometric Chart.	2	2	U
OR				
12 b	In a cooling application, moist air enters a refrigeration coil at the rate of 100 kg of dry air per minute at 35°C and 50% RH. The apparatus dew point of coil is 5°C and by-pass factor is 0.15. Determine the outlet state of moist air and cooling capacity of coil in TR.	2	2	Ap
13 a	Explain Air-Washer humidifier with neat sketch.	3	3	U
OR				
13 b	Explain Ejector type air distribution system with sketch.	3	3	U
14 a	Explain thermal exchanges of human body with the environment.	4	4	U

OR				
14 b	Explain the factors affecting Optimum effective temperature	4	4	Ap
15 a	Explain the construction and working of Split air conditioner with neat sketch.	5	5	Ap
OR				
15 b	Explain the construction and working of VRV System with neat sketch.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : V
Course Code : 9401 A
Course Title : Computer Aided Design and Manufacturing
Number of Periods per week : 5
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9401 A	Computer Aided Design and Manufacturing	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Computer Aided Design	12	0	0	12
2	Computer Aided Manufacturing	13	0	0	13
3	CNC Machine and its Components	13	0	0	13
4	Part Programming and Rapid Prototyping	14	0	0	14

5	CIM,FMS, Integrated Material Handling and Robot	13	0	0	13
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Draw the given machine component using CAD(UNIT 1)
2. Explain CAM activities (UNIT 2)
3. Explain construction of CNC Machines and its components(UNIT 3)
4. Manufacture a component using CNC machines and Rapid prototyping (UNIT 4)
5. Explain functions of CIM, FMS, AGV and Robots (UNIT 5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	COMPUTER AIDED DESIGN AND ANALYSIS	12	0	0
	1.1 CAD: Computer Aided Design: Introduction – definition – Shigley’s design process – CAD activities – benefits of CAD- Types of CAD system –CAD software packages.	4	0	0
	1.2 Transformations: 2D & 3D transformations – translation, scaling and rotation.	3	0	0
	1.3 Geometric modelling: Techniques - Wire frame modelling – 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 –	3	0	0

	Comparison.			
	1.4 Graphics standard: Definition – Need -DXF–IGES	2	0	0
2	COMPUTER AIDED MANUFACTURING	13	0	0
	2.1 Computer Aided Manufacturing: Introduction - Definition – functions of CAM – benefits of CAM.	2	0	0
	2.2 Group technology: Part families - Parts classification and coding - coding structure – Opitz system, MICLASS system and CODE System.	4	0	0
	2.3 Process planning: Introduction – Computer Assisted Process Planning (CAPP) – Types of CAPP - Variant type, Generative type – advantages of CAPP.	2	0	0
	2.4 Production Planning and Control (PPC): 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).	5	0	0
3	CNC MACHINE AND COMPONENTS	13	0	0
	3.1 CNC Machines: Numerical Control – Computer Numerical Control-definition – working principle of a CNC system – Features of CNC machines - advantages and disadvantages of CNC machines – difference between NC and CNC – Construction and working principle of turning centre – Construction and working principle of Horizontal and vertical machining centers – Machine axes conventions in turning centre and machining centre – Coordinate Measuring Machine - construction and working principle- Bridge type CMM-Advantages	7	0	0

	3.2 Components of CNC Machine: Drives – spindle drives – DC motor – feed drives – DC servo motor–AC Servo motor -Slide ways – requirement – types – friction slide ways and anti-friction slide ways - linear motion bearings – recirculating ball screw – ATC – tool magazine – feedback devices – linear and rotary transducers.	6	0	0
	PART PROGRAMMING AND RAPID PROTOTYPING	14	0	0
4	4.1 CNC Part Programming: Manual programming –Co-ordinate 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 format– program procedure- canned cycles - Simple programs in Lathe-stock removal and drilling operation– Simple programs in Machining centre- Linear and circular interpolation –contour milling – drilling cycle.	10	0	0
	4.2 Rapid prototyping: Classification - subtractive – additive – advantages and applications – materials. Types – Stereo lithography (STL) –3D printing	4	0	0
	CIM,FMS, AGV AND ROBOT	13	0	0
5	5.1 CIM: Introduction to CIM – concept of CIM – evolution of CIM – CIM wheel – benefits – integrated CAD/CAM.	3	0	0
	5.2 FMS: Introduction –FMS components – FMS layouts – - Types of FMS- Flexible manufacturing cell- Flexible turning cell-Flexible Transfer Line-Flexible Machining System- benefits of FMS- introduction to intelligent manufacturing system	4	0	0
	5.3 AGV: Introduction – AGV working principle – types – benefits.	2	0	0

	5.4 ROBOT: Definition – robot configurations – basic robot motion – robot programming method – industrial applications of robots -- material transfer and machine loading - welding, spray coating - assembly and inspection.	4	0	0
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TEXT BOOKS:

1. Radhakrishnan.P, Subramaniyan.S and Raju.V, “CAD / CAM / CIM”, New Age International Ltd, 2010.
2. Groover.M.PandZimmers, E.W, “Computer Aided Design and Manufacturing”, Prentice Hall of India, 2010.

REFERENCE BOOKS:

1. Ibrahim Zeid, “CAD / CAM Theory and Practice”, Tata McGraw Hill, 2001.
- 2.G.S. Sawhney. ‘Fundamentals of Computer Aided manufacturing’, IK International Publishing House,2011.
3. Posinasetti Nageswara Rao,” CAD/CAM: Principles and Applications”, Tata McGraw-Hill Education,2015

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

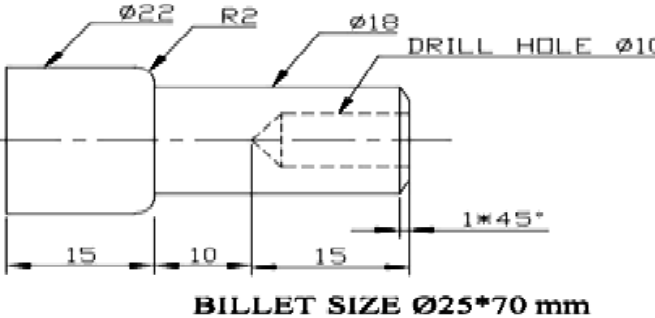
**Course Code & Course Title : 9401A – COMPUTER AIDED DESIGN AND
MANUFACTURING**

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	IGES stands for a) Initial Graphic Standard b) Initial Graphic Exchange Specification c) Interactive Graphics Engineering Solution d) Interactive Graphics Exchange Solution	1	1	R
2	MICLASS coding system consists of _____ digits a)10 - 20 b)12 - 30 c)10 - 15 d)18 - 30	2	2	R
3	In VMC, 'Z' axis is indicated as a) Longitudinal movement of table b) Crosswise movement of table c) Spindle linear movement d) Spindle rotary movement	3	3	U
4	In CNC Part programming, 'M06' refers to a) spindle ON b) coolant OFF c) program end d) tool change	4	4	R
5	Robot's arm is known as a) actuator b) end effector c) manipulator d) servo mechanism	5	5	R
Part- B				

Answer all questions. Each subdivision carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	List the types of CAD Systems .	1	1	R
6b	Differentiate CSG and B – rep.	1	1	R
7a	Define Group technology.	2	2	U
7b	State the advantages of CAPP?	2	2	R
8a	List the components of a CNC System	3	3	U
8b	Brief tool magazine, List its types	3	3	U
9a	Write the functions of the following codes used in (i) G75 (ii) G03 (iii) G28	4	4	U
9b	Write any three RPT techniques.	4	4	U
10a	List the components of FMS	5	5	U
10b	Write the types of robots based on mechanical configuration.	5	5	R
PART–C				
Answer all questions, choosing any one division from each (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	(i) Explain surface modeling technique with an example. (ii) List out the five major benefits of CAD.	1	1	U
OR				
11b	Explain the Graphic standard DXF.	1	1	U
12a	Explain Generative type CAPP with block diagram.	2	2	U

OR				
12b	Explain the concept of Shop Floor Control with block diagram.	2	2	U
13a	(i) Compare NC and CNC System. (ii) Write notes on ATC	3	3	U
OR				
13b	Explain the working of re circulating ball screw and nut arrangement with a neat sketch.	3	3	U
14a	Write a part program for producing the component shown below in CNC lathe.  BILLET SIZE Ø25*70 mm	4	4	Ap
OR				
14b	Explain 3D Printing technique in rapid prototyping.	4	4	U
15a	Explain the components and working principle of AGV.	5	5	U
OR				
15b	Discuss in detail about any four industrial applications of robots.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9401 B

Course Title : Mechatronics

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9401 B	Mechatronics	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total : 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Introduction to Mechatronics	10	0	0	10
2	Sensors	13	0	0	13
3	Signal Conditioners and Controllers	13	0	0	13
4	PLC & Electrical Controls for Fluid Power Systems	17	0	0	17
5	Case studies in Mechatronics	12	0	0	12
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Explain the elements of Mechatronics systems (Unit I)
2. Select an appropriate sensor for a given application (Unit II)
3. Select the suitable electrical or fluid control actuating system for given applications (Unit II& III)
4. Develop the PLC- ladder logic program for the given application (Unit III& IV)
5. Develop the application of Mechatronics system using suitable design process (Unit V)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	INTRODUCTION TO MECHATRONICS	10	0	0
	Definition, System – Types – Measurement and control system – open loop & closed loop system – elements, Examples of mechatronics system – Shaft speed control – Automatic washing machine – Digital camera – sequential control, Micro Processor based system			
2	SENSORS	13	0	0
	Performance terminology – Displacement, Position & Proximity Sensors – Velocity and Motion Sensors – Force Sensors – Fluid Pressure Sensors – Flow Sensors – Liquid Level Sensors – Temperature Sensors – Light Sensors – RADAR – LIDAR - Selection of Sensors.			
3	SIGNAL CONDITIONER AND CONTROLLERS	13	0	0
	Signal conditioning – processes, Op Amp – Inverting, Non inverting, summing, integrating, differential and logarithmic amplifier – Controllers – Types – P, D, I, PI, PID controllers, Digital Controllers – Speed and directional control of DC motor – H bridge. Brushless			

	DC motor – Stepper motor control – unipolar and Bipolar – Servo motors – Specification of stepper motor – Selection of motors			
4	PLC & ELECTRICAL CONTROLS FOR FLUID POWER SYSTEMS	17	0	0
	4.1: PLC: Definition – Block diagram – Input / output processing – programming methods – relay ladder logic – latching, timers, counters and Internal relays – Shift – data handling – Master and Jump Control – Planner machine control – Water pump control – Elevator (or) Lift control – Conveyor system control – selection of PLC	9	0	0
	4.2: ELECTRICAL CONTROLS FOR FLUID POWER SYSTEMS: Introduction – Electrical components – Control of Double acting cylinder (DAC) using single limit switch – reciprocation action of a cylinder using two limit switches – Dual cylinder sequence circuits – Box sorting system – Counting, timing and reciprocating action of DAC – Introduction to servo valves	8	0	0
5	CASE STUDIES IN MECHATRONICS	12	0	0
	Design process stages – Traditional Vs Mechatronics designs – Possible design solutions: Timed switch, Wind – screen wiper motion, weighing scale – Case studies of Mechatronics systems: A pick – and – place robot, Car park barrier, Bar code reader – Car engine management.			

TEXT BOOKS:

1. Bolton.W,"Mechatronics", Pearson Education(2011).
2. Andrew Parr, Hydraulics and Pneumatics, Jaico Publishing House (2011).
3. Elanchezhian C VijayaRamnath B," Applied Hydraulics and Pneumatics" Vayu Eduaction Publishers (2011).

REFERENCE BOOKS:

1. Devadas Shetty &Kolk " Mechatronics systems design", PWS Publishing Company (2007)
2. Petruzella D Frank, "Programmable logic controller", Tata Mcgraw-Hill (2010)
3. Anthony Esposito,"Fluid Power With Applications", Prentice Hall College Div (1996)

AUTONOMOUS EXAMINATION – QUESTION PATTERN**Time: 3 Hrs****Max. Marks: 75****Pattern of the Question Paper:**

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

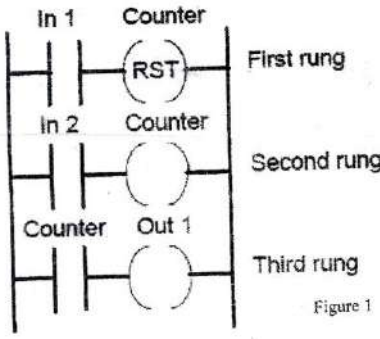
MODEL QUESTION PAPER

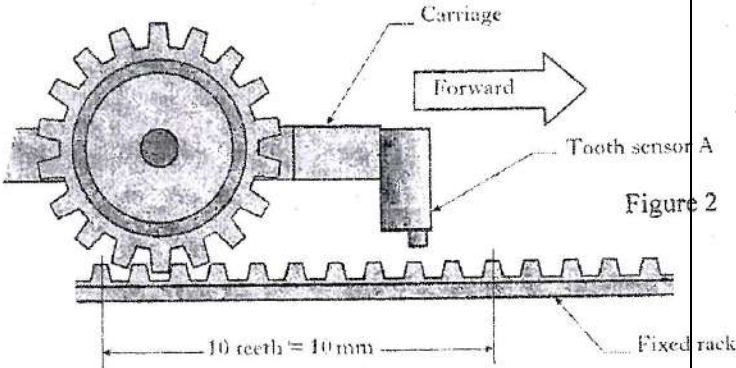
Course Code & Course Title : 9401 B - MECHATRONICS

Time : 3 Hrs

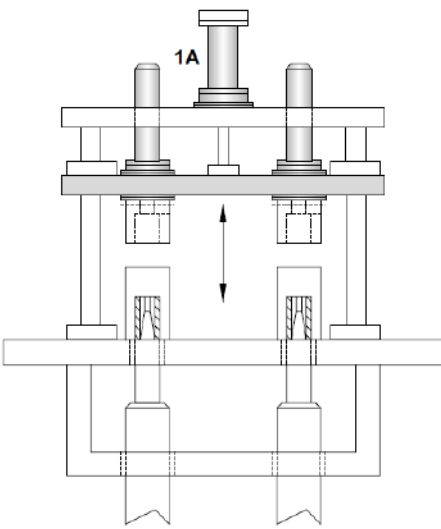
Marks : 75

Part – A				
Objective Questions: Answer all questions			(5X1= 5 Marks)	
Q. No	Questions	CO No	Unit No	Blooms Level
1	Where is the feedback generated by sensors in a mechatronics system given. a) input sensors b) comparator c) output sensor d) mechanical actuator	1	1	R
2	A thief enters bank at night .An alarm should function detecting this movement. The suitable sensor for this application is a) Capacitive sensor b) Hall effect sensor c) Pyroelectric sensor d) Piezoelectric sensor	2	2	U
3	Which frequency is attenuated in low pass filter? a) high frequency b) low frequency c) no frequency d) mid frequency	3	3	R

4	Decide whether each of these statements is True (T) Or False (F).For the following rung of ladder program there is an output when: i) Input 1 is momentarily activated ii) Input 2 is not activated  Which option best describes the two statements a) i) T ii) T b) i)T ii) F c) i) F ii) T d) i) F ii) F	4	4	Ap
5	In a car park barrier Mechatronics system design the output barrier movement is _____degree. a)60 b)180 c)90 d)120	5	5	U
Part – B				
Answer all questions: Each sub division carries 2 mark (10X2=20 Marks)				
Q. No	Questions	CO No	Unit No	Blooms Level
6 a)	Define mechatronics and list the examples of mechatronics system.	1	1	R
6 b)	The controlled variable in a closed loop system is a robot arm. Initially, it is at 55° C. It is commanded to 90° C to 30° C. Describe what happens in terms of set point, feedback, error and arm position.	1	1	Ap.

7 a)	Sketch the logic level output wave from for Tooth sensor when the carriage is moving in the forward direction as shown in the figure. 	2	2	Ap.
7 b)	How flow is detected using flow sensor?	2	2	R
8 a)	Draw the circuit diagram of summing amp	3	3	U
8 b)	How a servo motor differ from an ordinary industrial motor?	3	3	U
9 a)	What is the difference between electro mechanical relay and PLC.	4	4	U
9 b)	Draw the ladder rungs to represent A motor is switched ON by pressing a spring return push button-start switch, the motor remain ON until another spring return button stop switch is pressed.	4	4	Ap.
10 a)	Compare traditional and mechatronics design.	5	5	U
10 b)	Write any possible design solution for sorting small, medium and large size objects moving along with a conveyor belt so that, that are diverted down different chute packaging.	5	5	Ap.
Part – C				
Answer all questions				
Choosing any one division from each question.			(5x10=50 Marks)	
Q.	Question	CO	Unit	Blooms

No		No	No	Level
11 a)	Explain the elements of typical open loop control system. Design a open loop control system to maintain the required temperature of room with neat sketch and necessary block diagram	1	1	U
OR				
11 b)	Explain what is meant by microprocessor based system and illustrate your answer by an example through mechatronics approach	1	1	U
12 a)	Suggest a suitable sensor to measure the angular velocity of toothed wheel.	2	2	Ap.
OR				
12 b)	Explain the working principle of inductive proximity sensor and any two of temperature sensor.	2	2	U
13 a)	Explain the working of i) PI- controller ii) PID- controller	3	3	U
OR				
13 b)	i) Explain any one application of OP AMP. ii) Explain the operation of bipolar stepper motor with full step switching sequence by solid state devices.	3	3	U
14 a)	In an assembly station, components are to be put together. By pressing two push buttons the device is advanced and components are assembled. After releasing the push button switch, the device is returned to its start position. Give solution and its explanation with the pneumatic circuit and electrical circuit.	4	4	Ap.

				
OR				
14 b)	A process control system needs to maintain a temperature of 40°C. The process consists of a heater and cooling system. The temperature is measured using a thermocouple. Develop a ladder program for above process.	4	4	Ap
15 a)	With neat sketch, Give a possible design solution for working of car park barrier through mechatronics approach.	5	5	U
OR				
15 b)	Explain the mechatronics system of weighing scale with necessary block diagram	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9401 C

Course Title : Automobile Technology

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9401 C	Automobile Technology	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total : 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical	Total
1	Automobile Engines	13	0	0	13
2	Fuel and Fuel Feed Systems	13	0	0	13
3	Transmission and Power Trains	13	0	0	13
4	Automobile Chassis	13	0	0	13
5	Automobile Electrical Equipments & Hybrid Electric Vehicles	13	0	0	13
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Demonstrate the functioning of IC engine and its elements (Unit 1)
2. Demonstrate the functioning of fuel feed system (Unit 2)
3. Demonstrate the functioning of transmission system (Unit 3)
4. Demonstrate the functioning of various systems in chassis (Unit 4)
5. Demonstrate the functioning of electrical systems (Unit 5)
6. Explain the working of pollution control devices in an automobile vehicle (Unit 5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	AUTOMOBILE ENGINES	13	0	0
	1.1 Basic Engine Components Functions, types, materials and construction of Cylinder block – Crankcase – oil pan – Cylinder head – Gaskets – cylinder liners. Piston – piston rings – piston pin – Connecting rod – Crankshaft – flywheel – Cam shaft – methods of cam shaft drive arrangements – Valve - overhead valve operating mechanism.	6	0	0
	1.2 Cooling systems Cooling system - purpose – types – air and liquid cooling systems – merits and demerits – pump assisted water cooling system –Components – water pump, fan – thermostat– radiator – pressure cap. Troubles and causes in cooling system.	4	0	0
	1.3 Lubricating System Lubricating System - Purpose – types of lubricants – Service rating of oil - types of lubricating systems - Full pressure system - oil filters – full flow and bypass filter	3	0	0

	systems -Troubles and causes in lubricating system.			
2	FUEL AND FUEL FEED SYSTEMS	13	0	0
	2.1 Fuels & Combustion Requirements of an ideal petrol fuel – Octane number – detonation – Pre-ignition – properties of a good diesel fuel – Cetane number – Diesel knock – Stages of combustion of diesel engine - Alternate fuels for petrol and diesel engine (Ethanol, Methanol, Biodiesel , Hydrogen, CNG, LPG). Properties, Suitability, Merits and Demerits - Engine Modifications	5	0	0
	2.2 Layout of petrol fuel feed system Types of fuel feed systems – Electrical fuel feed pump – fuel filter – Air cleaner – types. Petrol injection– MPFI system– merits and demerits.	5	0	0
	2.3 Layout of diesel fuel feed system Electrical fuel feed pump – Inline fuel injection pump - fuel injector – types – Single & Multi hole - CRDI system - Turbocharger.	3	0	0
3	TRANSMISSION AND POWER TRAINS	13	0	0
	3.1 General arrangement of power transmission system Arrangement of front engine rear drive – front engine front drive – rear engine rear drive - four wheel drive – applications.	3	0	0
	3.2 Clutch Functions of clutch – Components – Types – Single plate diaphragm spring clutch and multi plate clutch - Fluid coupling - clutch troubles and causes.	3	0	0
	3.3 Gear box Purpose of gearbox – various resistance to motion – types of gear boxes – constant mesh and	3	0	0

	synchromesh - Transfer case - Automatic transmission (Description only) - gearbox troubles and causes.			
	3.4 Driveline Propeller shaft – slip joint – Universal joint – Cross type- Rzeppa joint.	2	0	0
	3.5 Final drive Functions of final drive – Hotch kiss drive. Differential - purpose – Construction and operation - Differential troubles and their Causes.	1	0	0
	3.6 Rear Axle Full floating axle, Three quarter floating axle.	1	0	0
4	AUTOMOBILE CHASSIS	13	0	0
	4.1 Front axle Front axle – Stub axle – types – Reversed Elliot Type.	1	0	0
	4.2 Steering system Ackermann Principle of Steering. Wheel alignment – Factors – Camber, Caster, King pin inclination and Toe-in. Steering gearbox - recirculating ball type - Rack and Pinion. Steering troubles and causes – power steering – Necessity - electronic power steering - collapsible steering system.	3	0	0
	4.3 Suspension system Functions of suspension system – Type of springs - Leaf, coil – Front suspension system - types – independent front suspension (Mac Pherson strut type and Double Wishbone arm type). Rear suspension – Leaf spring suspension - Air suspension – shock absorber- Anti roll bar suspension	3	0	0
	4.4 Brake system Functions of brake system – classification of brakes –	3	0	0

	drum brakes - leading shoe and trailing shoe – Self energizing action - disc brakes. Construction and working - Vacuum Assisted hydraulic brake - brake bleeding – Air brake – anti lock brake system - brake system troubles and causes.			
	4.5 Wheels Construction & Applications of wheels - disc, wire and alloy wheels.	1	0	0
	4.6 Tyres Functions of tyre – construction - Types - cross ply, radial ply & tubeless tyres.	2	0	0
5	UNIT V - AUTOMOBILE ELECTRICAL EQUIPMENTS & HYBRID ELECTRIC VEHICLES	13	0	0
	5.1 Automobile Electrical Equipments: Battery – lead acid battery -Nickel alkaline battery - construction – battery rating . Starting circuit - bendix drive mechanism. Charging circuit – alternator construction and operation – regulators – Dynamo. Ignition system - electronic ignition. Lighting circuit – head light aiming and adjustment - sealed beam head light - fluorescent lamp – directional signal circuit. Electric Horn. Windscreen wiper.	4	0	0
	5.2 Hybrid Electric Vehicles 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.	4	0	0
	5.2 Emission Standards: Euro I, II, III and IV norms, Bharat Stage II, III, IV norms. Motor Vehicle Act.	5	0	0

TEXT BOOKS:

- 1.Kirpalsingh, " Automobile engineering vol– 1, vol- 2 ", Standard publishers distributors, New Delhi(2011).
- 2.William H.crouse and Donald .L. Anglin ,Automotive Mechanics, Tata McGraw – Hill Publishing Company Ltd, New Delhi(1993).

REFERENCE BOOKS:

1. Heinz Heisler, "Vehicle and Engine technology. Vol. I", 1998 , ELBS
2. G.B.S.Narang (5th edition), Automobile Engineering, Khanna Publishers, New Delhi,1998.
3. The Automobile, Harbans Singh Reyat, S.Chand & Co Ltd, New Delhi
4. Automotive Mechanics, Joseph Heitner, East–west Press (P) Ltd, New Delhi
5. Modern Electric, Hybrid Electric and Fuel Cell Vehicles, Mehrdad Ehsani, Yimin Gao, Sebastien E.Gay, Ali Emadi, CR Press, London, New York.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title : 9401 C - AUTOMOBILE TECHNOLOGY

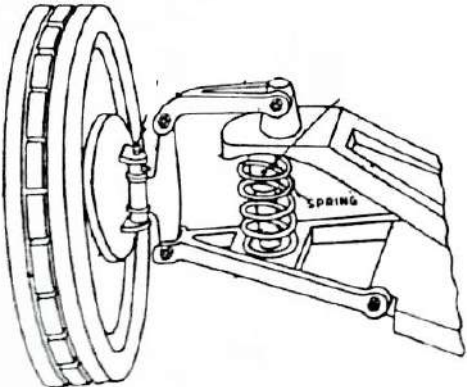
Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	The location of Thermostat valve in cooling system is a) at engine inlet from radiator b) at engine outlet to radiator c) between radiator and water pump d) between water pump and engine	1	1	R
2	The function of FIP is to a) Storing the fuel b) Filtering the fuel c) Deliver specific quantity of fuel at specific time d) Suck the fuel from the fuel tank	2	2	U
3	The type of rear axle drive employed in heavy duty vehicles is. a) Full floating axle b) Semi floating axle c) Three quarter floating axle d) One quarter floating	3	3	Ap

4	The type of wheel used in below shown image is  a) Alloy Wheel b) Spoked wheel c) Disc wheel d) Wire wheel	4	4	R
5	The specific gravity of fully charged battery is a) 1.11to 1.13 b) 1.20 to1.21 c) 1.22to1.26 d) 1.27 to1.29	5	5	U
Part- B				
Answer all questions. Each subdivision carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	Write the functions of gaskets.	1	1	U
6b	Write short notes on air cooling system	1	1	U
7a	Mention the additives used with petrol fuel.	2	2	U
7b	Write the advantages of using turbocharger in CI engine.	2	2	U
8a	Write the functions of clutch.	3	3	U
8b	List its types of rear axle drives used in heavy vehicles.	3	3	R

9a	Write the necessity of power steering.	4	4	U
9b	Write the functions of tyre.	4	4	U
10a	Write short notes on IC engine starting system.	5	5	U
10b	Write short notes on future scope of EVs	6	5	U
PART-C				
Answer all questions, choosing any one Question division from each division (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	Explain overhead valve operating mechanism with neat sketch.	1	1	U
OR				
11b	Explain full pressure lubricating system with neat sketch.	1	1	U
12a	Explain with neat sketch about the working of Inline FIP.	2	2	U
OR				
12b	Explain the fuel injection system used in modern Diesel engines.	2	2	U
13a	Name the gear box used in modern heavy duty vehicles. Explain its construction with a neat sketch.	3	3	U
OR				
13b	With help of neat sketch explain the working of conventional differential.	3	3	U

14a	Explain the below shown suspension system with neat sketch. 	4	4	U
OR				
14b	Explain the working of vacuum assisted hydraulic brake system with a sketch.	4	4	U
15a	Explain with neat sketch, the electronic ignition system.	5	5	U
OR				
15b	Explain with neat layout about the construction and working of Electric vehicles	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9307

Course Title : Refrigeration Practical

Number of Periods per week : 4

Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9307	Refrigeration Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Perform various installation operations on copper tube.
2. Determine the COP and Capacity of various R&AC systems.
3. Troubleshoot and Service a domestic refrigerator.

9307 - REFRIGERATION PRACTICAL

LIST OF EXPERIMENTS:

PART A:

1. A) Perform Cutting and flaring operation on Copper tube.
B) Perform Pinching, swaging and brazing operation on Copper tube.
2. A) Perform 45° & 60 ° bending operation on Copper tube.

- B) Perform 90° & U bending operation on Copper tube.
3. Charge refrigerant from suction side of the R&AC system
 4. Connect Wiring, starting and running of R&AC system with CSIR starting circuit.
 5. Connect Wiring, starting and running of R&AC system with RSIR starting circuit.

PART B:

1. Determine of percentage running time of Refrigerator with different settings of - Thermostat.
2. Determine of Refrigerating effect, COP of open type Refrigeration system with capillary tube as expansion device.
3. Determine of refrigerating effect, COP of sealed system with Thermostatic expansion valve in Refrigeration Test Rig
4. Determine of COP and capacity of ice plant.
5. Determine of COP and capacity of water Cooler test rig.
6. Trouble shoot and service of given domestic refrigerator.

SCHEME OF EXAMINATION:

S. NO	CONTENTS	MARKS ALLOTTED
I	<u>PART A</u> Operations performed on Copper tube	20
II	<u>PART B-EXPERIMENT:</u> Formula & Tabulation	10
	Observation (Readings) & Procedure	15
	Calculation/Graph	20
	Result	5
III	Viva Voce	5
	TOTAL	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 Onwards)

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9308

Course Title : Air-Conditioning Practical

Number of periods per week : 4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9308	Air-Conditioning Practical	3	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Determine the COP and capacity of given Air- Conditioning system
2. Service various Air-Conditioning systems

9308 - AIR-CONDITIONING PRACTICAL

LIST OF EXPERIMENTS

PART-A

1. Service Window Air Conditioner.
2. Service Split Air Conditioner.
3. Service Automobile Air-Conditioning system
4. Identify CSR terminal of sealed type compressor

5. Draw the wiring diagram of split Air Conditioner.

PART –B:

6. Determine the capacity and COP of window Air Conditioner.
7. Determine the capacity and COP of Split Air Conditioner.
8. Determine the efficiency of cooling tower.
9. Pump down the Refrigerant in a Split Air Air-Conditioning system.
10. Evacuate and Charge the refrigerant in Split Air Conditioner.
11. Locate the leak points in a given R&AC system.

SCHEME OF EVALUATION FOR END TERM EXAMINATION

SI. NO.	CONTENTS	MARKS ALLOTTED
I	<u>PART-A:</u>	20
	Trouble shoot and Service	
II	<u>PART-B:EXPERIMENT:</u>	
1	Formula & Tabulation	10
2	Observation (Readings) & Procedure	15
3	Calculation/Graph	20
4	Result	5
III	Viva Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9402 A

Course Title : CAD CAM Practical

Number of Periods per week :4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9402 A	CAD CAM Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Prepare geometrical model of various machine elements.
2. Draw the different views of machine elements.

9402 A– CAD/CAM PRACTICAL

Basics of Solid Modeling - Sketcher and Creation of Features & Datum Features-
Modification of Features - View Functions & Colors, File Import/ Export (Not For
Examination)

CAD DRAWING PRACTICE :

3D DRAWING – ASSEMBLY

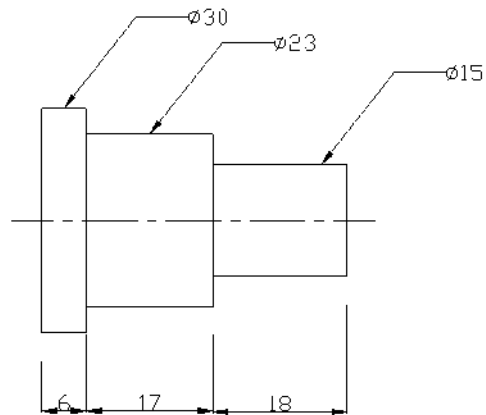
1. Sleeve & Cotter joint
2. Bushed bearing

3. Knuckle joint
4. Protected type flange coupling
5. Machine Vice
6. Screw jack

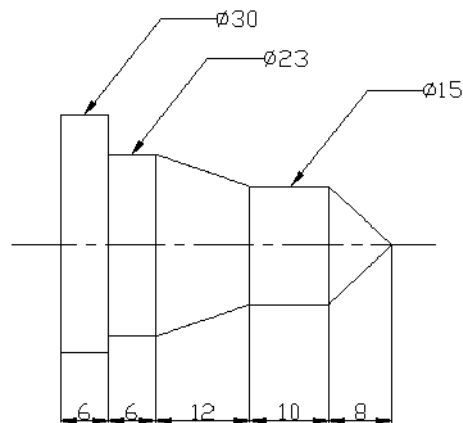
CAM PRACTICAL

CNC Turning Simulation

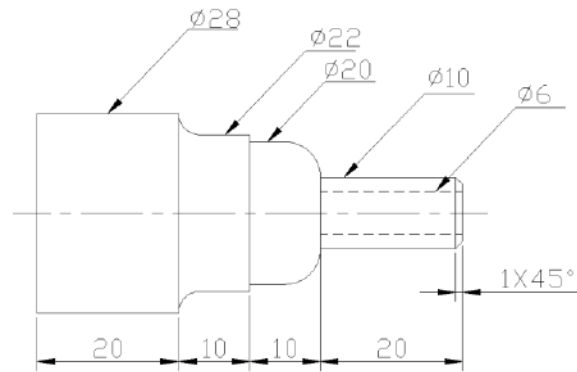
1. Create a part program for step turning and simulate in the software - Using Linear interpolation.



2. Create a part program for taper turning and simulate in the software - Using Box turning cycle.

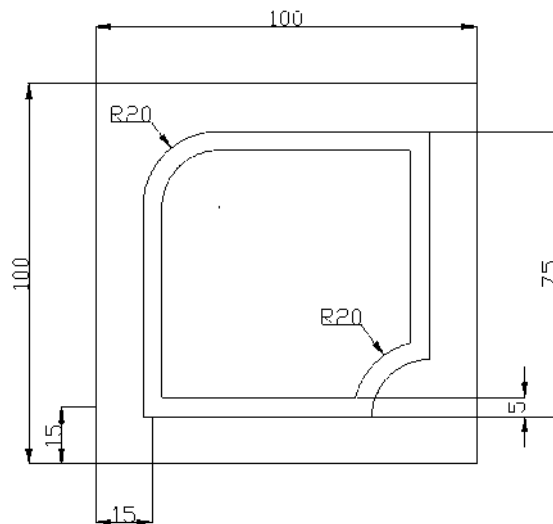


3. Create a part program for multiple turning operations and simulate in the software - Using drilling cycle.



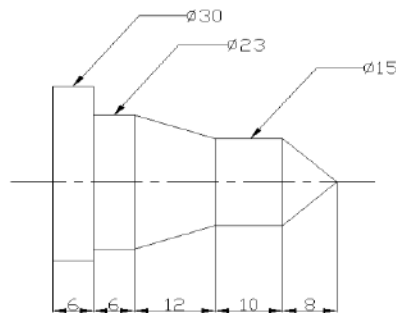
CNC Milling Simulation

1. Create a part program for grooving and simulate in the software - Using Linear interpolation and Circular interpolation.



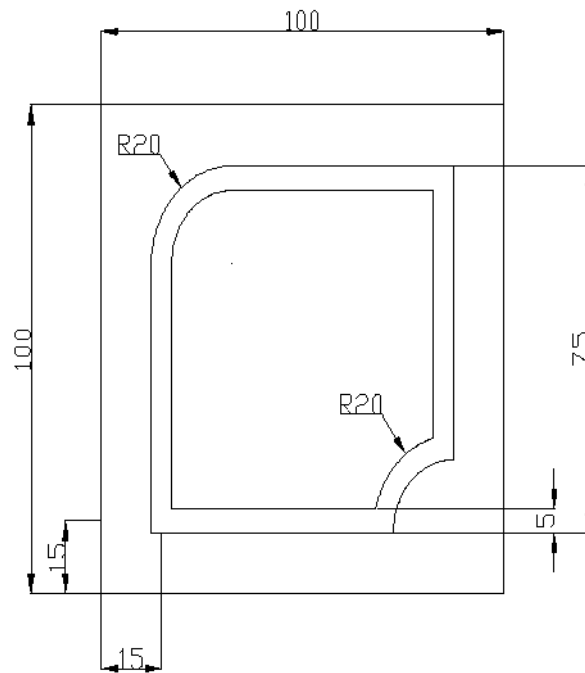
CNC Turning Machine Material: Aluminum

1. Using Box turning cycle – Create a part program for step and taper turning and produce component in the Machine.



CNC Milling Machine Material: Aluminum

1. Using Linear interpolation and Circular interpolation – Create a part program for grooving and produce component in the Machine.



SCHEME OF EXAMINATION:

S. NO	TOPIC	MARKS ALLOTTED
I	<u>CAD ASSEMBLY:</u>	
1	3D Drawing	25
2	Assembly, Dimension	15
3	Output	5
II	<u>CAM PROGRAMMING(SIMULATION):</u>	
1	Program and Simulation	15
2	Procedure	5
3	Execution and output	5
III	Viva- Voce	05
	TOTAL	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9402 B

Course Title : Mechatronics Practical

Number of Periods per week : 4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9402 B	Mechatronics Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to,

1. Devise a Control system for a given application
2. Design a program using PLC for actuating Fluid Power systems

9402 B-MECHATRONICS PRACTICAL

LIST OF EXPERIMENTS

1. PLC based direct operation of a motor using 'OR, AND, NOT, LATCH' logic control.
2. PLC based temperature control of electrical oven.
3. PLC based direct operation of On-Delay and Off –Delay control of a motor.
4. PLC based traffic light control.
5. PLC based automatic car parking system.

PLC based control of Electro pneumatic systems

6. Automatic operation of Double acting cylinder-Multi cycle.
7. Automatic operation of Double acting cylinder-N cycles (using counter function block)
8. Timer, Counter & Reciprocation Action of double acting cylinder
9. Sequential operation of double acting cylinder and a motor.
10. Sequential operation of two double acting cylinders for the sequence A+, B+, B-, A-.

SCHEME OF EVALUATION FOR END TERM EXAMINATION

SI. NO.	CONTENTS	MARKS ALLOTTED
1	Aim, Procedure	10
2	Ladder diagram & Pneumatic circuit	25
3	Simulation	25
4	Output & execution	10
5	Viva Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 9402 C

Course Title : Automobile Technology Practical

Number of Periods per week : 4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9402 C	Automobile Technology Practical	4	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Demonstrate the functioning of IC engine and its elements
2. Demonstrate the functioning of fuel feed system
3. Demonstrate the functioning of transmission system
4. Demonstrate the functioning of various systems in chassis
5. Demonstrate the functioning of electrical systems

9402 C AUTOMOBILE TECHNOLOGY PRACTICAL

LIST OF EXPERIMENTS

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. Dismantling and assembling of inline fuel injection pump and identification of parts.
4. Dismantling, assembling & testing of injectors.
5. Removing and replacing of pressure plate and clutch plate and identification of parts.
6. Dismantling, inspecting and assembling of gear box and identification of parts.
7. Dismantling and assembling of final drive and differential units and identification of parts.
8. Dismantling, assembling and adjusting of steering gear box and identification of parts.
9. Dismantling and assembling of starter motor & alternator and identification of parts.
10. Testing and charging of automobile battery.

SCHEME OF EVALUATION FOR ENDTERM EXAMINATION

S.NO.	CONTENTS	MARKS ALLOTTED
1	Dismantling of parts	30
2	Assembling	30
3	Identification of parts	10
4	Viva voice	05
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 Onwards)**

Programme : Mechanical Engineering (R&AC)

Term : V

Course Code : 2310

Course Title : Entrepreneurship and startups

Number of Periods per week : 4

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
2310	Entrepreneurship and startups	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 4-0-0 Periods / Week****Total : 64 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Entrepreneurship	10	0	0	10
2	Business Idea and Banking	10	0	0	10
3	Start ups, E-cell and Success Stories	10	0	0	10
4	Pricing and Cost Analysis	10	0	0	10
5	Business Plan Preparation	0	0	12	12
Field visit and Preparation of case study report					14
Total					64

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Prepare the start up plan using entrepreneurship concepts.
2. Prepare project feasibility report for selected product.

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	ENTREPRENEURSHIP	10	0	0
	Introduction and process concept, Functions and Importance - Myths about Entrepreneurship - Pros and Cons of Entrepreneurship - Process of Entrepreneurship - Benefits of Entrepreneur - 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.			
2	BUSINESS IDEA AND BANKING	10	0	0
	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			

	of State Government - Incentive schemes of Central Government.			
3	STARTUPS, E-CELL AND SUCCESS STORIES	10	0	0
	Concept of Incubation centre's - Activities of DIC, financial institutions and other relevant 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.			
4	PRICING AND COST ANALYSIS	10	0	0
	Calculation of Unit of Sale, Unit Price and Unit Cost - Types of Costs - Variable and Fixed, Operational Costs - Break Even Analysis - Understand the meaning and concept of the term 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.			
5	BUSINESS PLAN PREPARATION	0	0	12
	Generation of Ideas, Business Ideas vs. Business Opportunities - Selecting the Right Opportunity - Product selection - New product development and analysis - Feasibility Study Report – Technical analysis, financial - analysis and commercial analysis Market Research - Concept, Importance and Process - Marketing and Sales strategy - Digital marketing - Social Entrepreneurship - Risk Taking-Concept - Types of business risks.			

TEXT BOOKS

1. V.G. Patel, Entrepreneurship Development Programme in India, Entrepreneurship Development Institute of India, Ahmedabad.
2. M.S.ramesh, CC Pattenshetti, Madumathi M.Kulkarni , Business Communication, R.Chand & Co, New Delhi.
- 3.D.D Sharma, Marketing Research Principles, Applications and cases, Sultan Chand & Sons, New Delhi.
- 4.C.B.Gupta, N.P.Srinivasan, Entrepreneurial Development, Sultan Chand & Sons, New Delhi.

REFERENCE BOOKS:

1. S.S Khanka, Entrepreneurial Development, S Chand & Co, New Delhi.
2. B.R. Dey, Business Process Engineering, & Change Management, Bizlantra, New Delhi.
- 3.K.Aswathappa, International Business, TMH Company Ltd, New Delhi.
- 4.Prasanna Chandra, Financial Management, Tata McGraw Hill education private limited, New Delhi.

SCHEME OF EVALUATION:**Internal Marks:**

S.No	Description	Marks Allotted
1	Assignment (Theory Portion)* (4 x 10)	40
2	Seminar presentation (2 Seminars, each 25 marks)	50
3	Attendance	10
Total		100

External Marks:

Sl. No.	CONTENTS	MARKS ALLOTTED
Part-A	Written Examination (Unit I to IV) 10 questions(10x3 marks)	30
Part-B	Practical Examination – Submission of Business Plan / Feasibility Report	30
Part-C	Viva – Voce	15
Total		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 Onwards)**

Programme : Mechanical Engineering
Term : V
Course Title : Professional Skills (Teamness and Inter-Personal Skills)
Course Code : PS05
Number of hours per week : 1
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
PS05	Professional Skills (Teamness and Inter-Personal Skills)	-	-	-	-

TOPICS AND ALLOCATION OF PERIODS**L - T - P : 1 - 0 - 0 Hours / Week****Total : 16 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Harmony with self	3	0	0	3
2	Harmony with others	3	0	0	3
3	Group dynamics and conflicts resolution	4	0	0	4
4	Working in teams	3	0	0	3
Evaluation					3
Total					16

COURSE OUTCOMES

At the end of the course, the student will be able to,

- 1) Be aware of attitudinal, behavioral and emotional aspects of self
- 2) Prefer to learn continuously about self and be in harmony with self
- 3) Understand others' preferences, values, roles & contexts and be in harmony with others
- 4) Identify barriers to harmonious relationships and derive ways to handle them
- 5) Work collaboratively as a team to deliver expected outcomes

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	HARMONY WITH SELF	3	0	0
	Importance of learning about self continuously; Approaches to learn about self: introspection, being open to feedback, critical incidences as opportunities; Understanding life stages and challenges associated with them; Healthy ways of handling self in response to life's challenges; Instruments/inventories to understand self and others: A) Know your temperament, B) Mayer Briggs Type Indicator, C) Interpersonal Needs Inventory	3	0	0
2	HARMONY WITH OTHERS	3	0	0
	Importance of living in harmony with others; What it takes to live in harmony with others; Understanding preferences, values, roles and contexts of others; Approaches to navigating through differences between self and others; Barriers to harmonious relationships - Perceptions, Judgments, and Emotional instability; Ways to handle each of the barriers; Importance of reaching-out to others	3	0	0
3	GROUP DYNAMICS AND CONFLICTS RESOLUTION	4	0	0
	Group dynamics: overt and covert processes at micro and macro levels; Understanding the basis of conflicts;	4	0	0

	Understanding one's own conflict handling style; Methods to handling conflicts effectively.			
4	WORKING IN TEAMS	3	0	0
	Effectiveness in communication; Forming – storming – norming and performing model; Competition vs collaboration – impact of both on team tasks; TEAM Questionnaire – components of a healthy team and approaches to improving them.	3	0	0

Mode of delivery:

1. Learning Guided by Learner's workbook.

- i. Activities (experiential learning)
- ii. Audio visuals (affective learning)
- iii. Case discussions (cognitive learning)
- iv. Instruments/questionnaires (reflective learning)

2. Continuous learning guided by learning journal, and reviews by faculty

3. Half-day reinforcement session towards the end of the term

Tests and Grading

Sl. No.	Evaluation	Criterion	Total marks		Remarks
1	Course Evaluation	Comprehensive Examination and Viva voce	KT & SKT, short questions	20 marks	KT = Knowledge Test SKT = Scenario based Knowledge Test
			Viva voce	05 marks	
			Total	25 marks	

Grade

- 1) Marks between 25 to 20 – Excellent
- 2) Marks between 19 to 15 – very good
- 3) Marks between 14 to 10 good
- 4) Marks below 10 satisfactory

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Code : 9309
Course Title : Installation, Servicing & Applications of R&AC
Number of Periods per week : 6
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9309	Installation, Servicing & Applications of R&AC	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 6-0-0 Periods / Week****Total: 96 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Installation of Air Conditioning	16	0	0	16
2	Servicing of Refrigeration and Air Conditioning	16	0	0	16
3	Processing and Preservation of Food Products.	16	0	0	16
4	Application of air conditioning in hospitals and Commercial purpose.	15	0	0	15

5	Industrial Air Conditioning	15	0	0	15
Continuous Assessment Tests, Class Assignments and Revision					18
Total					96

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Install Air-conditioning system (UNIT-I)
2. Trouble shoot & Servicing of R and AC systems (UNIT-II)
3. Describe the functioning of food processing and preservations. (UNIT-III)
4. Describe the functioning of commercial and hospital air conditioning system. (UNIT-IV)
5. Describe the functioning of Industrial air-conditioning system (UNIT-V)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	INSTALLATION OF AIRCONDITIONINGSYSTEM	16	0	0
	Installation of Split, Cassette Type, packaged Air-conditioning -central air-conditioning- VRV System-chiller plant-Pump -cooling tower - Duct system -Air distribution system Gas charging of central air conditioning, split, packaged window system-HVAC systems.			
2	SERVICING OF REFRIGERATION AND AIRCONDITIONING SYSTEM	16	0	0
	Refrigerant recovery system-Safety procedures-Leak detection procedures- gauge manifold, gauges- safety controls-trouble shooting and Servicing of Refrigerator. Trouble shooting and servicing of window Air conditioner- Split Air conditioner- central air-conditioning system-Packaged air-conditioning, -			

	Cassette Type-VRV System- chiller plant – Servicing of cooling tower-Purging of evaporator coil.			
3	PROCESSING AND PRESERVATION OF FOOD PRODUCTS	16	0	0
	3.1 Processing And Preservation of Meat, Poultry Products Meat products - grading - slaughtering practices - ageing, artificial tenderizing, smoking, cooking and curing of meat–meat color changes - usages and table ready meats–freezing of meat - poultry products- processing plant operations- tenderness and flavor - eggs - composition and spoilage factors.	8	0	0
	3.2 Processing and Preservation of Milk Products, Beverages, Vegetables and Fruits Milk composition and grading -production practices - milk processing operations - types of milk - ice cream - composition and manufacturing procedure - cheese - types - cheese manufacture – beverages - classification and ingredients - Manufacture of carbonated nonalcoholic beverages - beer manufacture - wine manufacture – fermentation and other operations – coffee and tea processing and production practices – vegetables – properties and composition - post harvest practices - storage requirements of vegetables and fruits.	8	0	0
4	APPLICATION OF AIR CONDITIONING IN HOSPITALS AND COMMERCIAL PURPOSE.	15	0	0
	4.1 Hospital air conditioning: Necessity Requirements of air conditioning system for different departments – Diagnostic and	7	0	0

	treatment department – Nursery department – Surgical department – Emergency department – Service Department – Recovery rooms. Blood bank refrigeration – Storage temperature and equipments. Preservation of tissues – Storage temperature. Preservation of virus – Storage temperature and application – Effect of refrigeration on Blood, Tissues and Virus.			
	4.2 Commercial Applications: Commercial refrigerators – construction and working of reach in refrigerators, walk in coolers and display cases. Factors considered in designing air conditioning of hotels and restaurants. Air conditioning of departmental stores – Indoor and Outdoor conditions – Types of air conditioning system used – Essential features of air conditioning system used. Air-conditioning of theatres and auditoriums – Important heat load considered – Common design condition – Ventilation requirements.	8	0	0
5	INDUSTRIAL AIR CONDITIONING	15	0	0
	5.1 Industrial Applications: Industrial applications – Importance of RH indifferent industries – Equilibrium moisture content – Regain – Refrigeration for liquefied natural gas (LNG) – Gas liquefaction process for LNG. Manufacture and Heat treatment of metals. Heat treatment of metals – effect of humidity and temperature control – increased hardness, dimensional stability of tools and gauges, elimination	8	0	0

	of grinding Cracks, cutter tool life, high magnetic properties, workability, casting with frozen mercury patterns, fittings.			
	5.2 Textile Process Air Conditioning: Manufacturing process – factors determining optimum conditions – man machine and materials air conditioning systems – atomizer - air charger - air washer and duct systems.	4	0	0
	5.3 Special applications Air Conditioning: Air-conditioning of television centre, computer centre, automatic telephone exchange and museum Air-Conditioning.	3	0	0

TEXT BOOKS:

- 1.R.S. Khurmi and J.K. Gupta, “A text book of Refrigeration and Air-conditioning”,S.Chand publications, 2019.
2. C.P.Arora, “Refrigeration and Air-conditioning”, TaTaMcGraw Hill Educaion, 2021.
3. Manohar Prasad, “Refrigeration & Air Conditioning”, New Age International (P) Ltd, 2021.

REFERENCE BOOKS:

1. Arora and Domkundwar, “A course in Refrigeration and Air-conditioning by DhanpatRai& Co. ltd, 2018.
2. ROY J.Dossat, “Principles of Refrigeration”, Person Education Publication, 2002.
3. R.K.Rajput, “A text book of Refrigeration and Air-conditioning”, S.K. Kataria& Sons, 2013.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

**Course Code & Course Title : 9309 -INSTALLATION, SERVICING &
APPLICATIONS OF R&AC**

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions (5x1= 5 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	The outdoor unit of split AC requires space its surrounding to its Perimeter is a)12 inch b) 4 inch c) 9 inch d) 6 inch	1	1	R
2	Solenoid valve works on the principle of a) Magnetism b) Electromagnetism c) Flux d) Field elect	2	2	U
3	The quick freezing of food product is done by a) immersion freezing b) indirect freezing c)air blast freezing d) sharp freezing	3	3	R
4	For air conditioning the operation theater in a hospital, the percentage of outside air in the air supplied is a) Zero b) 20 c) 50 d) 100	4	4	U
5	The commonly used refrigerant in ice plant is a) NH ₃ b) CO ₂ c) R -12 d) R - 22	5	5	R
Part- B				
Answer all questions. Each subdivision carries 2mark (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	Classify ducts.	1	1	U

6b	Define HVAC system	1	1	R
7a	State the function of gauge manifold	2	2	R
7b	How pumping of evaporator coil is done?	2	2	U
8a	Define ageing	3	3	R
8b	Brief fermentation	3	3	R
9a	State the need of air conditioning in hospitals	4	4	R
9b	State the purpose of display cases	4	4	R
10a	How the humidity affects heat treatment?	5	5	R
10b	Brief the function of atomizer and air charger	5	5	R
PART–C				
Answer all questions, choosing any one division from each (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	Explain the step by step installation procedure of split air Conditioner?	1	1	U
OR				
11b	Explain the gas charging procedure of packaged air Conditioner?	1	1	U
12a	Explain the trouble shooting and servicing of packaged air conditioner.	2	2	U
OR				
12b	Explain the safety and leak detection procedures in air conditioning system.	2	2	U
13a	Discuss the preservation of meat in detail.	3	3	U
OR				

13b	Explain the wine manufacturing with a neat sketch.	3	3	U
14a	Explain the design criteria for major service areas in hospital air conditioning system.	4	4	U
OR				
14b	Explain the common design considerations and ventilation requirements for a theatre	4	4	U
15a	Explain the gas liquification process.	5	5	U
OR				
15b	Explain the textile air conditioning and factors determining the optimum conditions.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)
(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)
 Term : VI
 Course Code : 9310
 Course Title : Food Processing, Preservation and
 Transport Air-Conditioning
 Number of Periods per week : 5
 Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9310	Food Processing, Preservation and Transport Air-Conditioning	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS

L-T-P: 5-0-0 Periods / Week

Total : 80 Periods

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical / Drawing	Total
1	Food constituents and Food quality, Food processing Operations	13	0	0	13
2	Food spoilage factors and their control, Food dehydration	13	0	0	13
3	Heat processing preservation, Cold processing preservation	13	0	0	13
4	Automobile and Railway Air- Conditioning	13	0	0	13

5	Marine Air-Conditioning, Refrigerated Trucks and Trailors	13	0	0	13
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Explain the constituents, quality control and Processing of food products(unit 1)
2. Explain the spoilage factors and their controls in food products(unit2)
3. Explain the heat and cold process preservation of food products (unit 3)
4. Explain the Refrigeration in Transportation of Food products(unit 4&5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	FOODS CONSTITUENTS AND FOOD QUALITY, FOOD PROCESSING OPERATIONS	13	0	0
	1.1 Foods Constituents and Food Quality: Carbohydrates – proteins – fats natural emulsifiers – organic acids – oxidants and antioxidants – enzymes–pigments and colours – flavours – vitamins and minerals – natural toxicants – water - definition of food quality, Quality factors in foods, indicators of food quality - importance and ways of food quality assessment.	7	0	0

	1.2 Food Processing Operations: Materials handling - cleaning - separating - disintegrating - pumping - mixing - heating - cooling - evaporating - drying - forming - controlling - packaging - testing and Measurement - quality control.	6	0	0
2	FOOD SPOILAGE FACTORS AND THEIR CONTROL, FOOD DEHYDRATION	13	0	0
	2.1 Food Spoilage Factors and Their Control: Introduction—causes of food spoilage – bacteria, yeasts and molds – natural food enzymes – heat and cold – moisture and dryness – air and oxygen – light – time – control of spoilage – various methods of preservation – heating, cooling, freezing, dehydrating, irradiating, smoking, adding chemicals etc.	7	0	0
	2.2 Food Dehydration Reasons for drying — factors affecting dehydration like surface area, temperature, air velocity, dryness of air, atmospheric pressure, evaporation etc. – drying curve – physical and chemical changes—drying methods— various types of driers — Construction and working principle of driers.	6	0	0
3	HEAT PROCESSING PRESERVATION, COLD PROCESSING PRESERVATION 3.1 Heat Processing Preservation: Sterilization – pasteurization –blanching — heat resistant of microorganisms— heating food in containers— stillretort — agitating—	13	0	0

	pressure considerations—hydrostatic cooker and cooler – direct flame sterilization – in-package pasteurization — heating food before packing — batch and HTST pasteurization — aseptic canning - hot pack and hot fill — flash18process—microwaveheating	7	0	0
	3.2 Cold Processing Preservation : Refrigeration and freezing - refrigerated storage control of temperature, air circulation and humidity - storage requirements of perishable foods - freezing and frozen storage - characteristics of food being frozen—progressive freezing - methods of freezing - air blast freezing - IQF - direct and indirect freezing - immersion freezing - freezing with cryogenic liquids.	6	0	0
4	AUTOMOBILE AND RAILWAY AIR CONDITIONING	13	0	0
	4.1Automobileairconditioning: Sources of power – factors affecting cooling load – outdoor conditions –air leakage into passenger space – number of occupants, sun load, fresh air, variation of cooling load with automobile speed—basic components of automobile air conditioning—compressor, magnetic clutch, condenser, receiver and drier, expansion valve, evaporator, suction throttle valve, air distribution in passenger cars, car insulation, capacity and weight of air conditioning system – design consideration in bus air Conditioning – capacity and weight of air conditioner.	7	0	0

	4.2 Railway air conditioning: Location of air-conditioning equipments—types of power systems used –Axle driven system — engine driven compressor system—electro mechanical system – compression, cooling system and air distribution.	6	0	0
5	MARINE AIR CONDITIONING, REFRIGERATED TRUCKS AND TRAILORS	13	0	0
	5.1 Marine air conditioning: Design requirements – ambient and indoor conditions – special problems in ship air conditioning – air circulation and air conditioning machinery –safety of ships–ventilation requirements – air distribution methods – air-conditioning systems – single zone central system – multizone central system – terminal reheat system – control of design conditions – volume control, reheat control and air mixture control.	7	0	0
	5.2 Refrigerated trucks and Trailors: Temperature maintained for cold foods and frozen foods — types of refrigeration system – product sub cooling, using water ice, water ice in bunker with forced air circulation, using dry ice—using liquid nitrogen or carbon dioxide spray – eutectic plates with vehicle mounted condensing units — mechanical refrigeration with independent engine or electric motor, mechanical refrigeration deriving power from vehicle engine or transmission.	6	0	0

TEXT BOOKS:

1. Arora and Domkundwar, "A course in Refrigeration and Air-conditioning by Dhanpat Rai & Co. Ltd, 2018.
2. R.S. Khurmi and J.K. Gupta, "A text book of Refrigeration and Air-conditioning", S.Chand publications, 2019.
3. Manohar Prasad, "Refrigeration & Air Conditioning", New Age International (P) Ltd, 2021.

REFERENCE BOOKS:

1. C.P.Arora, "Refrigeration and Air-conditioning", TaTa McGraw Hill Educaion, 2021.
2. ROY J.Dossat, "Principles of Refrigeration", Person Education Publication, 2002.
3. R.K.Rajput, "A text book of Refrigeration and Air-conditioning", S.K. Kataria & Sons, 2013.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9310 - FOOD PRESERVATION AND TRANSPORT AIR-CONDITIONING

Time : 3 Hrs

Marks : 75

Part- A				
Objective Questions: Answer all Questions (5x1= 5 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	A process where food is first frozen at -18°C on trays and then under high vacuum is called as a) quick freezing b) cryogenic freezing c) freeze drying d) dehydro freezing.	1	1	U
2	The spoilage of food is due to a) desiccation b) enzymes c) micro organisms d) all of these	2	2	R
3	In air blast freezing the velocity of air varies from a) 5- 10 m/min b) 10 - 20 m/min c) 20 - 30 m/min d) 30 - 120 m/min	3	3	R
4	The compressor used in automobile air conditioner is normally a) reciprocating b) rotary c) scroll d) screw	4	4	R
5	The refrigerant tube used in marine refrigeration is a) steel b) copper c) mild steel d) aluminum	5	5	R
Part- B				
Answer all questions. Each subdivision carries 2 marks (10x2=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a	Write short notes on oxidants and antioxidants.	1	1	R

6b	Define food quality	1	1	R
7a	Write down the causes of food spoilage.	2	2	R
7b	Define dehydration	2	2	R
8a	Define pasteurization	3	3	R
8b	Define micro wave heating	3	3	R
9a	Write the factors affecting cooling load .	4	4	U
9b	List the types of power system.	4	4	U
10a	List the air distribution methods used in marine air conditioning	5	5	R
10b	List the types of refrigeration system used in trucks and trailers	5	5	R
PART-C				
Answer all questions, choosing any one division from each (5x10 = 50 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
11a	Explain the importance and ways of food quality assessment in detail	1	1	U
OR				
11b	Name the food constituents and explain any three in details	1	1	U
12a	Explain the methods of food processing in detail.	2	2	U
OR				
12b	Explain the construction and working principles of driers and factors affecting dehydration.	2	2	U
13a	Explain in detail about the batch and HTST pasteurization process	3	3	U

OR				
13b	Explain the various freezing process of food preservation in detail	3	3	U
14a	Explain the design and construction of bus air conditioner.	4	4	U
OR				
14b	Explain the rail road refrigerated cars in detail.	4	4	U
15a	Explain the design considerations in marine air conditioning.	5	5	U
OR				
15b	Explain the liquid nitrogen and carbon dioxide spray method with a neat sketch.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)
(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Code : 9403 A
Course Title : Design of R&AC Systems
Number of periods per week : 5
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9403 A	Design of R&AC Systems	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS

L-T-P: 5-0-0 periods / Week

Total: 80 Periods

UNIT	TOPICS	DURATION (Hours)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Cooling load calculations in Refrigeration	14			14
2	Cooling load calculations in Air - Conditioning	14			14
3	Fluid Flow and Duct Design	13			13
4	Air Distribution Systems, Noise Control and Insulating	12			12

	materials				
5	Selection of System components	12			12
Continuous Assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Estimate cooling load in a refrigeration system (UNIT-1)
2. Estimate cooling load in an Air-conditioning system (UNIT-2)
3. Design duct using various duct designing methods. (UNIT-3)
4. Explain air distribution system, various insulating materials and noise control methods. (UNIT-4)
5. Select suitable R&AC system components for a given application. (UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	COOLING LOAD CALCULATIONS IN REFRIGERATION	14	0	0
	Types of load-Wall gain load – Air change load – Product load – Miscellaneous load – Factors determining the wall gain load – Determination of the U factor – Temperature differential across cold storage walls – Temperature differential across ceilings and floors – Effect of solar radiation – Calculating the wall gain load , Air change load , Product load – Product freezing and storage – Respiration heat – Containers and packing materials – Calculating the miscellaneous load – Use of safety factor – simple Problems.			

2	COOLING LOAD CALCULATIONS IN AIRCONDITIONING	14	0	0
	Different types of heat sources – Sensible heat load – Latent heat load – Sensible heat factor – RSHF – GSHF – ESHF – Heat flow due to conduction – Sun load – Load due to direct radiation through glass – Periodic heat flow – Load from occupants – Equipment load – Infiltration air load – Miscellaneous heat sources – Duct heat gain – Fan load – Moisture gain through permeable walls and ceilings – Fresh air load – (No derivations, Definition only) – simple Problems			
3	FLUID FLOW AND DUCT DESIGN	13	0	0
	Duct-Classification-Duct materials – Duct Arrangement systems - perimeter system - perimeter loop system - Radial perimeter system – Extended volume system – Single duct system – Dual duct system Components – grills, resistors, diffusers –Pressure in ducts- continuity equation for ducts- Bernoulli's equation for ducts -Fluid flow and Pressure loss- Rectangular sections Equivalent to Circular Sections-Equivalent Length System for representing the other losses (No derivation) - Duct design- Simpleproblems.			
4	AIR-DISTRIBUTION SYSTEMS, NOISE CONTROLS AND INSULATING MATERIALS	12	0	0
	4.1AIR-DISTRIBUTION SYSTEMS Air distribution system: Introduction- Air distribution system for theatre and Auditorium - Upward air distribution – Overhead air distribution - Ejector distribution system-Factors considered in air distribution – throw – drop-	4	0	0

	entrainment ratio- ventilation systems- effect of Vertical Temperature gradients and corrective measures.			
	4.2 NOISE AND NOISE CONTROL Introduction- Basic Acoustics- Sources of Noise in Air-Conditioning Systems- Methods of Noise control- Noise Attenuation in Pipes and Ducts	4	0	0
	4.3 INSULATING MATERIALS Properties of insulating materials – Types of insulating material – Natural materials – wool type insulators – foils – cell type (rubber) insulations-heat transfer through insulation – Economical thickness of insulation – Adoption of insulation and Selection.	4	0	0
	SELECTION OF SYSTEM COMPONENTS	12	0	0
5	Selection of reciprocating compressor – Centrifugal compressor –Screw compressor-Scroll compressor- Air cooled condenser – Water cooled condenser – Evaporator – Design step for reciprocating, centrifugal compressor, Screw and Scroll compressor - Design steps for water cooled condenser- Design steps for evaporator– No problems – No derivations Selection of cooling tower -selection of pump for water circulation-selection of capillary tube- selection of Automatic expansion valve – selection of thermostatic expansion valve- No problems – No derivations.			

TEXT BOOKS:

1. R.S. Khurmi and J.K. Gupta, "A text book of Refrigeration and Air-conditioning", S.Chand publications, 2019.
2. C.P.Arora, "Refrigeration and Air-conditioning", TaTaMcGraw Hill Educaion, 2021.
3. Manohar Prasad, "Refrigeration & Air Conditioning", New Age International (P) Ltd, 2021.

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2. ROY J.Dossat, "Principles of Refrigeration", Person Education Publication, 2002.
3. R.K.Rajput, "A text book of Refrigeration and Air-conditioning", S.K. Kataria& Sons, 2013.

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A - 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B -5 Questions with two subdivisions taken from each unit. Each question carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

MODEL QUESTION PAPER

Course Code & Course Title: 9403A - DESIGN OF R&AC SYSTEMS

Time: 3 Hrs

Marks: 75

Part- A				
Objective Questions: Answer all Questions			(5x1= 5 Marks)	
Q. No.	Question	CO No.	Unit No.	Blooms Level
1	The factor of safety for cooling load in refrigeration is a) 11% of total load b) 20% of total load c) 10% of total load d) 25% of total load	1	1	U
2	Human body in a cooled space constitutes cooling load of a) Sensible load b) Latent load c) Sensible and load d) Unpredictable	2	2	R
3	Aspect ratio of rectangular duct is a) 8 b) 10 c) 12 d) 16	3	3	R
4	In summer, air is a) cooled and humidified b) cooled and dehumidified c) heated and humidified d) heated and de humidified	4	4	U
5	The expansion devices are used to a) reduce the high pressure liquid into low pressure b) increase the low pressure liquid into high pressure c) equalize the system's pressure d) equalize the system's temperature	5	5	R
Part- B				
Answer all questions. Each sub division carries 2 marks (5x4=20 Marks)				
Q. No.	Question	CO No.	Unit No.	Blooms Level
6a)	Define Cooling load	1	1	R

6b)	List miscellaneous heat sources in estimating refrigeration cooling load.	1	1	R
7a)	Define RSHF.	2	2	R
7b)	Differentiate Ventilation and Infiltration heat load.	2	2	U
8a)	Classify the ducts.	3	3	R
8b)	Differentiate Static and Dynamic Pressure in ducts.	3	3	U
9a)	Define noise in an Air-Distribute system.	4	4	R
9b)	State the methods of noise control.	4	4	R
10a)	Write down any two design steps for reciprocating compressor.	5	5	R
10b)	Compare air cooled condenser with water cooled condenser.	5	5	U

PART-C

Answer all questions, choosing any one Question division from each division
(5x10 = 50 Marks)

Q. No.	Question	CO No.	Unit No.	Blooms Level
11 a	Explain the following in detail i) Wall gain load ii) Product load	1	1	U
OR				
11 b	300 kg of poultry enter a chiller at 5 ° C and are frozen and chilled to a final temperature of -15 ° C for storage in 12 hours. Compute the product load in Kilowatts.	1	1	Ap
12 a	Discuss various sensible and latent heat sources in detail.	2	2	U

OR				
12 b	Hall is to be maintained at 24°C dry bulb temperature and 60% relative humidity under the following conditions: Outdoor design conditions =38°C DBT and 28°C WBT Sensible heat load in the room =46.4 KW Latent heat load in the room = 11.6 KW Total infiltration air = 1200 m³/h Apparatus dew point temperature=10°C Quantity of recirculated air from the hall =60% If the quantity of recirculated air is mixed with the conditioned air after the cooling coil, Find the following: i) The condition of air leaving the conditioner coil and before mixing with the recirculated air ii)The condition of air before entering the hall	2	2	Ap
13 a	Explain various duct designing methods in detail.	3	3	U
OR				
13 b	Derive Bernoulli's equation for ducts.	3	3	Ap
14 a	Explain the following with neat sketch: i)Upward air distribution system ii)Ejector air distribution system	4	4	U
OR				

14 b	Explain the properties of Insulating materials in detail.	4	4	U
15 a	Describe the design procedure of a reciprocating compressor.	5	5	U
OR				
15 b	Explain Thermostatic expansion valve with neat sketch.	5	5	U

Note: Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)

Term : VI

Course Code : 9403 B

Course Title : Cryogenic Engineering

Number of Periods per week : 5

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9403B	Cryogenic Engineering	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Cryogenic Systems	13	0	0	13
2	Cryogenics Refrigeration Systems	13	0	0	13
3	Separation And Purification Systems	13	0	0	13
4	Measurement Systems	13	0	0	13
5	Applications of Cryogenics	13	0	0	13
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Understand basic concepts of Cryogenics(UNIT-1)
2. Explain Cryogenics Refrigeration Systems(UNIT-2)
3. Explain Separation and Purification Systems(UNIT-3)
4. Explain measurement of low temperature and pressure(UNIT-4)
5. Explain Applications of Cryogenics(UNIT-4)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	CRYOGENIC SYSTEMS	13	0	0
	Introduction to Refrigeration and Air conditioning systems. Cryogenic systems – Gas liquefaction systems. Simple Linde – Hampson systems – Claude system – system for neon, hydrogen and helium liquefaction systems.			
2	CRYOGENICS REFRIGERATION SYSTEMS	13	0	0
	Cryogenics refrigeration systems – Claude refrigerator, Philips refrigerator – Solvay refrigerator – Gifford – Magnetic cooling system – Magnetic refrigeration systems.			
3	SEPARATION AND PURIFICATION SYSTEMS	13	0	0
	Separation and Purification systems – Air separator systems – Linde double column systems Argon, Neon, Hydrogen and Helium separation systems.			
4	MEASUREMENT SYSTEMS	13	0	0
	Measurement systems for Temperature, Pressure, Liquid level measurement.			
5	APPLICATIONS OF CRYOGENICS	13	0	0
	Applications of cryogenics – Rocket propulsion – Separation of Rubber from old tyres. Medical applications – Increasing the tool life application.			

TEXT BOOKS:

1. R.S. Khurmi and J.K. Gupta, "A text book of Refrigeration and Air-conditioning", S.Chand publications, 2019.
2. C.P.Arora, "Refrigeration and Air-conditioning", TaTaMcGraw Hill Educaion, 2021.
3. Manohar Prasad, "Refrigeration & Air Conditioning", New Age International (P) Ltd, 2021.

REFERENCE BOOKS:

1. Arora and Domkundwar, "A course in Refrigeration and Air-conditioning by DhanpatRai& Co. Ltd, 2018.
2. ROY J.Dossat, "Principles of Refrigeration", Person Education Publication, 2002.
3. R.K.Rajput, "A text book of Refrigeration and Air-conditioning", S.K. Kataria& Sons, 2013.

9403 B CRYOGENIC ENGINEERING**Model Question Paper****Duration: 3 Hrs****Max. Marks: 75**

Part- A				
Objective Questions: Answer all Questions (5X1= 5 Marks)				
Q. No.	Question	CO NO	Unit No.	Blooms Level
1	The cryogenic range temperature is from a. -156.6°C to absolute zero b. -140°C to absolute zero c. -153.2°C to absolute zero d. -150°C to absolute zero	1	1	R
2	The Claude system operates at a. lower compression ratio b. higher compression ratio c. compression ratio is one d. compression ratio is zero	2	2	U
3	The following device is used to measure the temperature of cryogenics a. Cryogenic sensor b. Thermocouple c. Thermometer d. Rotometer	3	3	R
4	Air separation system consists of Air filter system, Air compression system, Air pre cooling system and a. Expansion system b. Heating system c. Purification system d. Analysing system	4	4	R
5	In medical applications, Cryogenics is used in a. CT scan b. X – ray c. MRI scan d. ECG	5	5	U

PART – B				
II. Answer all subdivisions in the following questions: (5X4=20) Each subdivision carries 2 markss				
Q. No.	Question	CO NO	Unit No	Blooms Level
6 a)	Define Cryogenics.	1	1	R
6 b)	Write short notes on Hampson system?	1	1	R
7 a)	State the working principle of Magnetic cooling.	2	2	R
7 b)	Briefly write about Claude Refrigerator.	2	2	U
8 a)	List the purpose of air separator.	3	3	R
8 b)	Write notes on Helium separator	3	3	R
9 a)	List the pressure measurement instruments used in Cryogenics.	4	4	R
9 b)	List the temperature measurement instruments used in Cryogenics.	4	4	R
10 a)	How do you increase the tool life using cryogenics	5	5	U
10 b)	Name any four applications of Cryogenics	5	5	R
PART – C				
III. Answer all questions, choosing any one Question division from each division (5X10=50)				
Q. No	Question	CO NO	Unit No	Blooms Level
11 a)	Explain the construction and working principle of simple Linde System	1	1	U
OR				
11 b)	Explain the construction and working principle of Helium Liquefaction System.	1	1	U
12 a)	With neat diagram, explain the working of Claude refrigerator	2	2	U
OR				

12 b)	Discuss the construction and working principle of Magnetic Cooling System	2	2	U
13 a)	Explain the construction and working principle of Linde Double Column system.	3	3	U
OR				
13 b)	Describe the construction and working principle of Hydrogen and Helium Separation systems.	3	3	U
14 a)	Explain the procedure of measuring Cryogenic temperature.	4	4	U
OR				
14 b)	Explain the procedure of measuring Cryogenic pressure,	4	4	U
15 a)	Discuss in detail about 'Rocket Propulsion'.	5	5	U
OR				
15 b)	Explain in detail about any five applications of Cryogenics in medical field.	5	5	U

Note:

Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 onwards)**

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Code : 9403C
Course Title : Green Energy and Energy Conservation
Number of Periods per week : 5
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9403C	Green Energy and Energy Conservation	3	25	75	100

TOPICS AND ALLOCATION OF PERIODS**L-T-P: 5-0-0 Periods / Week****Total: 80 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Fundamentals of Energy, Geothermal energy, Wind energy	13	0	0	13
2	Bio mass energy, Solar Energy	13	0	0	13
3	Photovoltaic (PV)	13	0	0	13
4	PV Technologies, Applications	13	0	0	13

5	Energy conservation	13			13
Continuous assessment Tests, Class Assignments and Revision					15
Total					80

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Explain about the fundamentals of Energy. (UNIT-1)
2. Understand construction and principle of Wind energy, Solar energy, Geothermal and Bioenergy. (UNIT-2)
3. Understand the PV design and its components (UNIT-3).
4. Understand the energy conservation process. (UNIT-4)
5. Understand the Government Policies and Act (UNIT-5)

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	FUNDAMENTALS OF ENERGY, GEOTHERMAL ENERGY, WIND ENERGY	13	0	0
	1.1 Energy: 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. 1.2: Geothermal energy: Introduction–Essential characteristic– Sources–Power Plants–Single flash power plant–double flash power plant–Flow diagram and principle only. 1.3 Wind energy: Introduction–energy conversion– site selection – considerations–Components of wind energy conversion system– Classification.			

	Windmill: Horizontal axis machines –Vertical axis – machines working principle, advantages and disadvantages. Schemes for electric generation.			
2	BIOMASSENERGY,SOLARENERGY	13	0	0
	2.1: Bio mass energy: Introduction – conversion technologies: Wet processes – dry processes. Bio gas generation – factors affecting the biogas 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. 2.2 Solar Energy: 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.			
3	PHOTOVOLTAIC(PV)	13	0	0
	Photovoltaic (PV): 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) –Production of Siwafersing of making-monocrystalline-multicrystalline - Waferdicing. sheets. Solargrade			

	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.			
4	PV TECHNOLOGIES, APPLICATIONS	13	0	0
	PV Technologies: 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 – superstrate arrangement. Solar PV module: series and parallel connections of cells –mis match in cell/module-Design and structure of PV module. Batteries for PV systems–factors affecting battery performance–DC to DC converters–Charge controllers–DC to AC converter (inverter) (Description only). Applications: Flat plate collector-concentrating solar collectors–solar pond–solar water heating–space heating and cooling–solar pumping– solar cooking solar green house. Principle and application only.			
5	ENERGY CONSERVATION	13	0	0
	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 –Appel late tribunal for energy conservation — Energy Conservation Guidelines for Industries by BEE, Govt of India -Guide lines — 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.Net-metering policies Tamill Nadu. Energy Development Agencies– Projects in Tamil Nadu: Solar energy, Bio energy and Wind energy — Tamil Nadu Solar policy2019.			
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TEXT BOOKS:

1. D.A. Ray ,”Industrial energy conservation”.- Pergaman Press
2. Kirpal Singh Jogi,” Energy resource management, ,Sarupand sons.
3. Chetan Singh Solanki,” Solar Photo vltatics, ,PHI Learning Pvt.Ltd.

REFERENCE BOOKS:

1. G.D.Rai Non Conventional Energy Sources,,Khanna Publishers.
2. R.K.Rajput, Non Conventional Energy Sources and Utilisation, S.Chand & Company Ltd.
3. Stephen Peake Renewable Energy, , Oxford press

AUTONOMOUS EXAMINATION – QUESTION PATTERN

Time: 3 Hrs

Max. Marks: 75

Pattern of the Question Paper:

PART A- 5 Objective Questions, one question from each unit. Each question carries one mark.

PART B- 5 Questions with two subdivisions taken from each unit. Each carries two marks.

PART C - 5 Questions with two subdivisions taken from each unit. Answer any one Sub division from each question. Each subdivision carries ten marks.

Questions are to be numbered from 1 to 15 continuously

SECTION	TOTAL NUMBER OF QUESTIONS	NUMBER OF QUESTIONS TO BE ANSWERED	ALLOTED MARKS	TOTAL MARKS
PART A	5	5	1	5
PART B	10	10	2	20
PART C	5 (Either or type)	5	10	50
TOTAL				75

Model Question Paper
9401C - GREEN ENERGY AND ENERGY CONSERVATION

Time: 3Hrs

Max. Marks: 75

Part- A				
Objective Questions: Answer all Questions			(5X1= 5 Marks)	
Q. No.	Question	Co No	Unit No.	Blooms Level
1	Which of these is not a renewable source of energy? a. The sun b. Wind c. Natural gas d. Ocean tidal energy	1	1	R
2	Photovoltaic energy is the conversion of sunlight into: a. Chemical energy b. Biogas c. Electricity d. Geothermal energy	2	2	R
3	Windmill towers are generally more productive if they are a. higher, to minimize turbulence and maximize wind speed b. lower, to minimize turbulence and maximize wind speed c. lower, to increase heat convection from the ground d. higher, to increase heat convection from the ground	3	3	U
4	Both power and manure is provided by: a. Nuclear plants b. Thermal plants c. Biogas plants d. hydroelectric plant	4	4	R
5	Energy derived from hot spots beneath the earth is called a. Bio energy b. geothermal energy c. Nuclear energy d. Hydrogen energy	5	5	R

PART – B				
II. Answer all questions in the following sub deviations:				(5X4=20)
Each questions carries 2 marks				
Q. No.	Question	CO NO	Unit No	Blooms Level
6 a)	Name Renewable sources of energy.	1	1	R
6 b)	Write the disadvantages of Conventional energy sources?	1	1	R
7 a)	Compare Flat plate and Concentrating Collectors.	2	2	U
7 b)	Brief solar furnace?	2	2	R
8 a)	How does a wind turbine work?	3	3	U
8 b)	List the types of wind machines.	3	3	R
9 a)	State the difference between biomass and fossil fuels	4	4	U
9 b)	State biomass gasification	4	4	R
10 a)	Brief the environmental impact of using Geothermal energy	5	5	U
10 b)	List any two applications of geothermal energy.	5	5	R
PART – C				
III. Answer all questions, choosing any one division from each question.				(5X10=50)
Q. No	Question	CO NO	Unit No	Blooms Level
11 a)	Explain the sources of renewable Energy?	1	CO1	U
OR				
11 b)	List out Energy density of various fuels.	1	CO1	U
12 a)	How do you estimate average solar radiation?	2	CO1	A
OR				
12 b)	Explain flat plate collectors and concentrating plate collectors	2	CO1	U
13 a)	Describe the major applications of wind power	3	CO1	U

OR				
13 b)	Explain the factors to be considered for site selection for wind power generation	3	CO1	A
14 a)	Describe the process of converting urban waste to energy	4	CO1	A
OR				
14 b)	Describe the process of Biomass to Ethanol production	4	CO1	U
15 a)	Explain the generation of Tidal power in detail.	5	CO1	U
OR				
15 b)	Explain the working of Solid Oxide Fuel Cell.	5	CO1	U

Note:

Code for Blooms Levels:

Sl. No.	Blooms Level	Code
1	Remember	R
2	Understand	U
3	Apply	Ap

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)
(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Code : 9311
Course Title : HVAC Drawing and CAD Practical
Number of Periods per week: 5
Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9311	HVAC Drawing and CAD Practical	3	25	75	100

Course outcomes

1. Draw R&AC Components and symbols.
2. Prepare process drawing R&AC system.

9311- HVAC Drawing and CAD Practical

LIST OF EXERCISES

PART-A-MANUAL DRAWING

1. Draw Basic R&AC Components and symbols
2. Draw basic R&A/C components — Part 1 (HVAC equipments symbols like - FCU, AHU, chiller, pump, fan, cooling coil, compressor, silencer, muffler, aor filter, drier, condenser, thermostat, dx unit, cooling tower, gate valve, globe valve, solenoid valve, butter fly valve, check valve)

3. Draw basic R&A/C components — Part 2 - (HVAC duct work symbols like – straight duct, bend, branch duct, junction, y junction, 3 way junction, beveled junction, miter bend, transition, offset transition, diffuser supply & return, duct heater, flexible connection, flexible connector, damper, vav box, linear diffuser supply & return, floor register, louver opening, air grill)
4. Draw the Compressor connection drawing
5. Draw the Condenser connection drawing
6. Draw the Evaporator connection drawing
7. Draw the Process drawing of Split Air-Conditioner
8. Draw the Process drawing of Typical duct drawing for a hall
9. Draw the Process drawing of Chillers
10. Draw the Process drawing of a Cooling tower
11. Draw the Process drawing of Typical central A/C plant

PART-B-CAD PRACTICALS

PART-B: COMPUTER AIDED DRAFTING (CAD)

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– LT scale – Matching properties – Editing with grips – P edit – D d edit – Ml edit - Basic dimensioning – Editing dimensions – Dimension styles–Dimension system variables. Machine drawing with CAD. Creation of blocks–W block–inserting a block Block attributes–Hatching–Pattern types –Boundary hatch – working with layers – Controlling the drawing

display – Blip mode – View group commands –Zoom, redraw, regen, regen auto, pan, viewers –Real time zoom.

Exercises:

12. Sl.no 2&3 are compulsory (Any two of drawings from sl.no 4 to 6)

13. Anyone of the process drawing (from sl.no 7 to 11)

SCHEME OF EVALUATION FOR END TERM EXAMINATION

S. NO	TOPIC	MARKS ALLOTTED
I	<u>PART-A:</u>	
	Aim and Procedure	05
	Manual Drawing	25
	Result	05
II	<u>PART-A:</u>	
	Aim and Procedure	05
	CAD Drawing	25
	Print out	05
III	Viva- Voce	05
	Total	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)
(2021 Regulations)
(To be implemented from the Academic Year 2022-2023 Onwards)

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Title : Design of R&AC Systems Practical
Course Code : 9404 A
Number of periods per week : 4
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9404 A	Design of R&AC Systems Practical	3	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Estimate the cooling load of given room to be Air-Conditioned
2. Determine the capacity and efficiency of Air and Water cooled condenser.
3. Perform thermal analysis in an Automobile Air Conditioner test rig
4. Select a suitable R&AC Components for a given application

9404 A -DESIGN OF R&AC SYSTEMS PRACTICAL

LIST OF EXPERIMENTS

1. Fabricate square type duct and explain various types of duct, sheet metal duct joints.

2. Fabricate reducer type duct.
3. Draw Different types of finned surfaces.
4. Select a suitable Reciprocating compressor for the given tonnage of Air conditioner with design and selection parameters.
5. Select a suitable Screw/ Scroll compressor for the given tonnage of Air conditioner with design and selection parameters.
6. Select a suitable Condenser for the given tonnage of Air conditioner with design and selection parameters.
7. Select suitable Evaporators for the given tonnage of Air conditioner with design and selection parameters.
8. Determine the capacity and efficiency of Air cooled condenser.
9. Determine the capacity and efficiency of water cooled condenser
10. Estimate the cooling load for the given room to be air-conditioned.
11. Perform Thermal Analysis using Computerized Automobile Air Conditioner test rig.

SCHEME OF EVALUATION FOR END TERM EXAMINATION

SI. NO.	CONTENTS	MARKS ALLOTTED
I	<u>PART-A:</u>	20
	Fabrication / Design procedure	
II	<u>PART-B: EXPERIMENT:</u>	
1	Formula & Tabulation	10
2	Observation (Readings) & Procedure	15
3	Calculation/Graph	20
4	Result	5
III	Viva Voce	5
TOTAL		75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering
Term : VI
Course Code : 9404 B
Course Title : Cryogenics Engineering Practical
Number of Periods per week:4
Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9404 B	Cryogenics Engineering Practical	4	25	75	100

COURSE OUTCOMES:

1. About Liquefaction of gas, Neon, Hydrogen and Helium.
2. About Magnetic Cooling systems
3. Separation of Argon, Neon and Hydrogen using Linde system
4. Measure of cryogenic temperature, Pressure and liquid level

9404 B - CRYOGENICS ENGINEERING PRACTICAL

VI-Term (Diversified Course)

PART-A

1. Identification of liquefaction of Neon.
2. Identification of Liquefaction of Hydrogen.
3. Identification of Liquefaction of Helium.
4. Identification of microscopic structure of tool grain size (cryogenic treatment).
5. Identification of cryogenics in space applications.

PART-B

6. Separation of Argon by using Linde double columns system.
7. Separation of Neon by using Linde double columns system.
8. Separation of Hydrogen by using Linde double columns system.
9. Measurement of cryogenic Temperature.
10. Performance test on cascade refrigeration system

SCHEME OF EXAMINATION:

S. NO	TOPIC	MARKS ALLOTTED
I	<u>PART-A:</u> Study Exercise	20
II	<u>PART-B:EXPERIMENT:</u>	
1	Aim & Procedure	10
2	Formula, tabulation	10
3	Observation	15
4	Model Calculation	10
5	Result	5
III	Viva Voce	5
	Total	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 onwards)

Programme : Mechanical Engineering (R&AC)

Term : VI

Course Code : 9404 C

Course Title : Green Energy and Energy Conservation Practical

Number of Periods per week: 4

Total Number of weeks per term: 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9404 C	Green Energy and Energy Conservation Practical	4	25	75	100

Course outcomes:

1. To demonstrate the I-V and P-V Characteristics of PV module
2. To understand how to use various electrical measuring equipments

9404 C - Green Energy and Energy Conservation Practical
VI-Term (Diversified Course)

EXPERIMENTS

PART A

1. Study and demonstrate the I-Van dP-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 set up.
5. Study the wind power generation status in Tamilnadu.
6. Study the biogas generation status in Tamilnadu.

PART B

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 standalone 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 mono crystalline and polycrystalline silicon solar panel.

SCHEME OF EXAMINATION:

S. NO	TOPIC	MARKS ALLOTTED
I	<u>PART-A:</u> Study Exercise	20
II	<u>PART-B:EXPERIMENT:</u>	
1	Aim & Procedure	10
2	Formula, tabulation	10
3	Observation	15
4	Model Calculation	10
5	Result	5
III	Viva Voce	5
	Total	75

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)

(2021 Regulations)

(To be implemented from the Academic Year 2022-2023 Onwards)

Programme : Mechanical Engineering (R&AC)

Term : VI

Course Title : Project work and Internship

Course Code : 9312

Number of hours per week : 6

Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
9312	Project work and Internship	3	25	75	100

COURSE OUTCOMES

At the end of the course, the student will be able to

1. Implement the theoretical and practical knowledge gained through the Curriculum into an application suitable for a real practical working environment preferably in an industrial environment.
2. Implement the planned activity as a team.
3. Take appropriate decisions on collected information.

9312-PROJECT WORK AND INTERNSHIP

SCHEME OF EVALUATION FOR END TERM EXAMINATION

The Project work must be reviewed thrice in the same term. The project work is approved during the V term by the properly constituted committee with guidelines.

a) Internal assessment mark for Project Work and Internship:

Sl. No.	Contents	Marks Allotted
1	Periodic report performance (Not less than 3 reviews)	20
2	Project report preparation	20
3	Model Examination I. Internship review-20 marks II. Demonstration and viva voce-30 marks	50
4	Attendance	10
Total		100

Total marks (100 marks) will be converted to 25 marks for internal assessment mark calculation. Proper record should be maintained for the three Project Reviews and preserved for one term after the publication of Autonomous Exams results. It should be produced to the flying squad and the inspection team at the time of inspection/verification.

b) Internship Report:

The internship training for a period of four weeks shall be undergone by every candidate at the end of III/ IV / V Term 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.

c) Allocation of Marks for Project Work and Internship in Board Examinations:

Sl. No.	Contents	Marks Allotted	Marks Obtained
1	Demonstration/Presentation	20	
2	Project Report	20	
3	Internship Report	20	
4	Viva Voce	15	
TOTAL		75	

DIPLOMA IN MECHANICAL ENGINEERING (R&AC)**(2021 Regulations)****(To be implemented from the Academic Year 2022-2023 Onwards)**

Programme : Mechanical Engineering (R&AC)
Term : VI
Course Title : Professional Skills (Campus to corporate)
Course Code : PS06
Number of hours per week : 1
Total Number of weeks per term : 16

Scheme of Examination

Course Code	Course Name	End term Examination			
		Duration Hrs	Internal Marks (I)	External Marks (E)	Total Marks (T = I + E)
PS06	Professional Skills (Campus to corporate)	-	-	-	-

TOPICS AND ALLOCATION OF PERIODS**L - T - P : 1 - 0 - 0 Hours / Week****Total : 16 Periods**

UNIT	TOPICS	DURATION (Periods)			
		Lecture	Tutorial	Practical/ Drawing	Total
1	Gratitude and social responsibility	2	0	0	2
2	The world of business (get to the specifics of behavioral responses to certain specific contexts)	4	0	0	4
3	Transition from a campus	3	0	0	3

	mindset to corporate mindset				
4	Preparedness to adapt to work culture	2	0	0	2
5	Presentable and agile	2	0	0	2
Evaluation					3
Total					16

COURSE OUTCOMES

At the end of the course, the student will be able to

- 1) Display gratitude and social responsibility
- 2) Understand various business environments – industry & function wise
- 3) Explain the transition from a campus mindset to corporate mindset
- 4) Be prepared to adapt to the future work culture
- 5) Choose to be presentable and agile

DETAILED SYLLABUS

UNIT	TOPICS	PERIODS		
		L	T	P
1	GRATITUDE AND SOCIAL RESPONSIBILITY	2	0	0
	Importance of gratitude; Finding opportunities to give back to society; Responsible behavior in public places; Volunteerism during calamities; Social relevancy during engineering design and manufacturing – how social issues could be tackled by engineering solutions;	2	0	0
2	THE WORLD OF BUSINESS (GET TO THE SPECIFICS OF BEHAVIORAL RESPONSES TO CERTAIN SPECIFIC CONTEXTS)	4	0	0
	World of business - Perceptions vs reality; Various business types - B2B, B2C, & other business models; Various industry verticals – fundamentals, dynamics & nuances; Nature of work as per various functions – Sales & Marketing, Service, Research & Development, Production etc; Self-reflective questionnaire to identify the	4	0	0

	fitment to a particular field/function			
3	TRANSITION FROM A CAMPUS MINDSET TO CORPORATE MINDSET	2	0	0
	ROCK as an acronym (Responsibility, Ownership, Contribution, Knowledgeable (continuous learning)); Responsibility – ways in which responsibility should be demonstrated; Ownership – owning one’s career, owning mistakes, desisting from complaining; Contribution – focus on creating value, giving more than receiving (salary & perks); Knowledgeable(continuous learning) – learning just begins after campus, aspects of learning mindset, various opportunities to learn and how they can be utilised at work;	2	0	0
4	PREPAREDNESS TO ADAPT TO WORK CULTURE	2	0	0
	Skills to get through selection process – Interview conversations, resume writing, group discussion& presentation; Handling Cultural differences; Handling Gender dynamics; Alignment to Ethics and values; Alignment to work processes & code of conduct; Handling multiple (often conflicting) demands; Handling peer influence; Conducting sensitively with subordinates, peers & boss; Managing personal finance; Maintaining work-life balance – work & social life, hobbies etc;	2	0	0
5	PRESENTABLE AND AGILE	2	0	0
	Dressing & grooming – Reasons for good dressing & grooming; Professional etiquette—what is etiquette, professional etiquette vs social etiquette, Aspects of professional etiquette; Wellness – Healthy eating habits, Importance of sleep, Importance of fitness; Importance of cleanliness of surroundings – desk, work area, place of stay (5S);	2	0	0

Mode of delivery:

1. Learning Guided by Learner's workbook.

- i. Activities (experiential learning)
- ii. Audio visuals (affective learning)
- iii. Case discussions (cognitive learning)
- iv. Instruments/questionnaires (reflective learning)

2. Continuous learning guided by learning journal, and reviews by faculty

3. Half-day reinforcement session towards the end of the term

Tests and Grading

Sl. No.	Evaluation	Criterion	Total marks		Remarks
1	Course Evaluation	Comprehensive Examination and Viva voce	KT & SKT, short questions	20 marks	KT = Knowledge Test SKT = Scenario based Knowledge Test
			Viva voce	05 marks	
			Total	25 marks	

Grade

- 1) Marks between 25 to 20 – Excellent
- 2) Marks between 19 to 15 – very good
- 3) Marks between 14 to 10 good
- 4) Marks below 10 satisfactory

ANNEXURE- I

FORMAT FOR PREPARATION OF PROJECT REPORT

1. SEQUENCE OF PROJECT REPORT DOCUMENT:

The sequence in which the project report document to be arranged and bound should be as follows:

1. Title Page
2. Bonafide certificate
3. Acknowledgement
4. Abstract
5. Table of Contents
6. List of figures
7. List of tables
8. Chapters
 - Introduction
 - Literature survey
 - Proposed Work
 - Design / Development of proposed Work
 - Description of hardware/software used
 - Working/Validation of proposed work
 - Cost estimation
 - Conclusion
9. Bibliography/References
10. Photograph (Optional)

2. PAGE DIMENSION AND BINDING SPECIFICATIONS:

The dimension of the project report should be in A4 size. The project report should be bound using **flexible cover** of the thick white art paper. The cover should be **printed in black letters** and the text for printing should be identical.

3. PREPARATION FORMAT:

Cover Page & Title Page – Format is given in **Appendix 1**

Bonafide Certificate –Format is given in **Appendix 2**

Abstract – Abstract should be one page synopsis of the project report

Table of Contents –A specimen copy of the Table of Contents of the project report is given in **Appendix 3.**

List of Tables – The list should use exactly the same captions as they appear above the tables in the text. One and a half spacing should be adopted for typing the matter under this head.

List of Figures – The list should use exactly the same captions as they appear below the figures in the text. One and a half spacing should be adopted for typing the matter under this head.

Chapters:

- Each chapter should be given an appropriate title.
- Tables and figures in a chapter should be placed in the immediate vicinity of reference

List of References – The listing of references should be in alphabetical order in Single spacing left – justified as given below.

- [1] M. C. Shaw, Metal cutting principles, 2nd ed. New York: Oxford University Press, 2005.
- [2] B. M. Swami, K. S. R. Kumar, and C. H. Ramakrishna, “Design And Structural Analysis Of Cnc Vertical Milling Machine Bed,” Int. J. Adv. Eng. Technol., vol. 3, no. 4, pp. 97–100, 2012.
- [3] S. K. H. Choudhary and S. K. Bose, Elements of Workshop Technology, 4th ed., vol. II : Machine Tools. Bombay: Media Promoters & Publishers PVT.LTD.

TYPING INSTRUCTIONS:

- The impression on the typed copies should be black in colour.
- One and a half spacing should be used for typing the general text. The general text shall be typed in the Font style ‘Times New Roman’ and Font size 14.

APPENDIX 1

(A typical specimen of Cover Page & Title Page)

TITLE OF PROJECT REPORT

<1.5 line spacing>

A PROJECT REPORT

MONTH & YEAR

Submitted by

<Italic>

NAME OF THE CANDIDATE(S) & Register No

<Italic>

Guided by

NAME OF THE GUIDE

Submitted in partial fulfillment for the award of the Diploma in

<1.5 line spacing><Italic>

BRANCH OF STUDY



NACHIMUTHU POLYTECHNIC COLLEGE

POLLACHI - 642 003

**Government Aided * Autonomous Institution * Approved by AICTE, New Delhi
Affiliated to State Board of Technical Education and Training, Tamil Nadu.**

Accredited by APACC

(Asia Pacific Accreditation and Certification Commission),
Philippines with Gold Medal

APPENDIX 2
(A typical specimen of Bonafide Certificate)

NACHIMUTHU POLYTECHNIC COLLEGE
POLLACHI - 642 003

AUTONOMOUS INSTITUTION

Accredited by APACC

(Asia Pacific Accreditation and Certification Commission),
Philippines with Gold Medal

BONAFIDE CERTIFICATE

Certified that this project report entitled

“..... TITLE OF THE PROJECT”

Is the bonafide record work carried out by

“NAME.....” – “ROLL NO.....”

During the academic year 2021- 2022.

<Name>
GUIDE

<Name>
HEAD OF THE DEPARTMENT

INTERNAL EXAMINER

EXTERNAL EXAMINER

NAME: _____

NAME: _____

DESIGNATION: _____

DESIGNATION: _____

APPENDIX 3

TABLE OF CONTENTS

CHAPTER NO.	TITLE	PAGE NO.
	TITLE PAGE	I
	BONAFIDE CERTIFICATE	III
	ACKNOWLEDGEMENT	V
	ABSTRACT	VII
	TABLE OF CONTENT	IX
	LIST OF FIGURES	XI
	LIST OF TABLES	XIII
1	INTRODUCTION	1
	1.1.	
	1.2.	
2	LITERATURE SURVEY	
3	PROPOSED WORK	
4	DESIGN / DEVELOPMENT OF PROPOSED WORK	
5	DESCRIPTION OF HARDWARE/SOFTWARE USED	
6	WORKING/VALIDATION OF PROPOSED WORK	
7	COST ESTIMATION	
8	CONCLUSION	
9	BIBLIOGRAPHY/REFERENCES	
10	PHOTOGRAPH	

ANNEXURE- II

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9203 Strength of Materials and Fluid Mechanics Practical

TERM: III

S.NO	NAME OF THE EQUIPMENT	Nos
01	Rockwell"s Hardness testing machine	1
02	Izod and Charpy machine	1
03	Universal Testing Machine (UTM)	1
04	Shear testing machine	1
05	Torsion testing machine	1
Fluid Mechanics		
07	Bernoulli's apparatus.	1
08	Arrangement to find friction factor of pipe.	1
09	Reciprocating pump with collecting tank arrangement to find the efficiency and to plot the characteristics curves.	1
10	Centrifugal pump with collecting tank arrangement to find the efficiency and to plot the characteristics curves.	1
11	Centrifugal pump having discharge line with venturimeter or orifice meter arrangements.	1
12	Centrifugal pump having discharge line with small orifice arrangements.	1

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9204 & Thermal Engineering Practical

TERM: III

S.NO	NAME OF THE EQUIPMENT	Nos
01	Open cup apparatus	1
02	Closed cup apparatus	1
03	Redwood viscometer	1
04	Saybolt viscometer	1
05	Four stroke diesel and petrol engine model	1 No each
06	Four stroke petrol or diesel engine test rig	1
07	Multi-cylinder petrol engine test rig	1
08	Air compressor test rig	1
09	Measuring instruments	Sufficient quantity
10	Tools, Safety Equipments	Sufficient quantity
11	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME:9302 R & AC Machines Practical

TERM:III

S.NO	NAME OF THE EQUIPMENT	Nos
01	Hermetically sealed compressor fitted with discharge gauge setup	1
02	R & AC System Service tools	1 set
03	Refrigerator with electronic thermostat set.	1
04	Window air conditioner test rig, anemometer, and Sling psychrometer.	1
05	Experimental setup of blower, anemometer.	1
06	VCR system test rig with LP and HP cut out	1
07	Open type system test rig with automatic expansion valve and thermostatic expansion valve and thermostat control	1
08	VCR system with OLP, selector switch	1
09	Hermetically sealed compressor ,Open type compressor cut section,	1
10	Compressor with VFD driven motor	1
11	Measuring instruments	Sufficient quantity
12	Tools, Safety Equipments	Sufficient quantity
13	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9205& Manufacturing Technology Practical **TERM:**IV

S.NO	NAME OF THE EQUIPMENT	Nos
1	Moulding board	30
2	Patterns	5 each
3	Cope box	30
4	Drag box	30
5	Core box	10
6	Runner & riser	60
7	Gate cutter	30
8	Draw spike	30
9	Vent rod	30
10	Brush	20

S.NO	NAME OF THE EQUIPMENT	Nos
11	Shovel	20
12	Rammer set	30
13	Slick	30
14	Strike-off bar	30
15	Riddle	15
16	Trowl	30
17	Lifter	30
18	Sprue pin	60
19	Brush	20
20	Flux	500 grams
21	Safety Glass	15
22	Arc welding booth	2
23	Electrode 10 SWG	200

S.NO	NAME OF THE EQUIPMENT	Nos
24	Face shield	3
25	Gas welding goggles	2
26	Leather Gloves 18"	4 Set
27	Set Flux chipping hammer	4
28	Center Lathe 4 ½ „ Bed length	15
29	4 Jaw / 3 Jaw Chucks	required Numbers
30	Chuck key (10 mm x 10 mm size)	15
31	Box spanner	15
32	Cutting Tool H.S.S ¼ „ X ¼ „ X 4 „ long	15
33	Pitch gauge	5
34	Vernier Caliper (0-25 and 25-50)	5 each
35	Micrometer, Inside and Outside(0-25 and 25-50)	5 each

S.NO	NAME OF THE EQUIPMENT	Nos
36	Vernier Height Gauge(300mm)	1 no
37	Parallel Block	2
38	Steel Rule (0-150)	15
39	Outside and Inside Calipers	15 each
40	Thread gauge	5
41	Jenny Caliper	5
42	Dial Gauge with Magnetic Stand	5
43	Marking Gauge	10
44	Universal Milling Machine	2
45	Cylindrical Grinding Machine	1
46	Tools and Measuring instruments	Sufficient quantity
47	Consumables	-Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9206 &Electrical and Electronics Engineering Practical

TERM:IV

S.NO	NAME OF THE EQUIPMENT	Nos
1	DC Shunt Motor 3.7 KW with Loading Arrangement	1
2	1 Phase Transformer 2KVA, 220V/110V	2
3	1 Phase Variac 15 amps	2
4	Single Phase Resistive Load 3 KW, 220V	3
5	Tachometer Analog /Digital type	1
6	Rheostat – various ranges 170 Ω /2A, 220 Ω /1.4A	2
7	AC Ammeter – various ranges 0-1A, 0-5A, 0-15A, 0-30A	8
8	DC Ammeter – various ranges 0-10mA, 0-2A, 0-5A, 0-10A, 0-15/30A	8
9	DC Voltmeter – 0-5/10V, 0-30V, 0-300V	8
10	AC Voltmeter – 0-150V, 0-300V	8

S.NO	NAME OF THE EQUIPMENT	Nos
11	Wattmeter – various ranges LPF 150/300/600V 2.5A/5A,1/2.5A	2
12	Wattmeter – various ranges UPF 150/300/600V 10/20A	2
13	Dual Regulated Power Supply 0-30V/2A	4
14	Single Regulated Power Supply 0-30V / 2A	4
15	Decade Resistance Box	2
16	CRO with probe	2
17	Transformer 230/9-0-9V,1A	3
18	Decade capacitance box	1
19	Measuring instruments	Sufficient quantity
20	Tools, Safety Equipments	Sufficient quantity
21	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 Students in Practice/ End term Examinations)

COURSE CODE & NAME : 9207 - Machine Drawing Practical

TERM: IV

1. A class room with 30 Drawing Tables.
2. Drawing instruments are given to each students at the beginning of the term as per requirements.

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME:9304& Heat Transfer Practical

TERM:IV

S.NO	NAME OF THE EQUIPMENT	Nos
1	Pin fin apparatus natural,forced.	1
2	Stefan boltzman apparatus	1
3	Heat transfer through Composite walls	1
4	Thermal conductivity apparatus	1
5	Natural convection apparatus	1
6	Forced convection apparatus	1
7	Emissivity measurement apparatus	1
8	Parallel flow, counter flow heat exchanger	1
9	Thermal conductivity apparatus (ghm)	1
10	Measuring instruments	Sufficient quantity
11	Tools, Safety Equipments	Sufficient quantity
12	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9307& REFRIGERATION PRACTICAL

TERM: V

S.NO	NAME OF THE EQUIPMENT	Nos
1	Refrigeration tools kit. (cutting, bending, flaring, swaging, pinching)	4 set
2	Brazing setup	2
3	Open type refrigeration system and gauge manifold set	1
4	Refrigerator test rig	1
5	Ice plant test rig.	1
6	Water cooler test rig	1
7	VCR with sealed system test rig	1
8	VCR with open type system test rig	1
9	Hermetic compressor, Tong tester, Multimeter	1
10	Refrigerant charging kit	1
11	Domestic refrigerator	2
12	Measuring instruments	Sufficient quantity
13	Tools, Safety Equipments	Sufficient quantity
14	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9308 & AIR CONDITIONING PRACTICAL

TERM: V

S.NO	NAME OF THE EQUIPMENT	Nos
1	Window air conditioner for service	1
2	Split Air Conditioner for service	1
3	Automobile air conditioner setup for service	1
4	Service cylinder filled with refrigerant, p-h chart for different refrigerants	1
4	Window air conditioner test rig, anemometer, sling psychrometer	1
5	Split air conditioner test rig, anemometer, sling psychrometer	
6	Cooling tower test rig	1
7	Air washer test rig	
8	VCR system with CSR circuit	1
9	VCR system with PSC circuit	1
10	VCR system with CSCR circuit	1
11	Vacuum pump, charging kit	1
09	Measuring instruments	Sufficient quantity

10	Tools, Safety Equipments	Sufficient quantity
11	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9402A & CAD/CAM PRACTICAL

TERM: V

S.NO	NAME OF THE EQUIPMENT	Nos
1	Personal computer	30
2	3D Solid Modelling software	Sufficient to the strength
3	CNC Simulation software	Sufficient to the strength
4	Consumables	Sufficient quantity
5	Laser / Inkjet Printer	1 No
6	Measuring instruments	Sufficient quantity
7	Tools, Safety Equipments	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 Students in Practice/ End term Examinations)

COURSE CODE & NAME : 9402B - Mechatronics Practical

TERM : V

S.NO.	NAME OF EQUIPMENT	No's
1	Electro Pneumatic Trainer Kit	2 No's
2	PLC module with Software	2 No's
3	Desktop Computer	15 No's
4	Compressor and Accessories	1 No
5	Power Supply Unit, Connecting Leads and Hoses	As per Requirements
6	Consumables	Sufficient quantity
7	Tools	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 Students in Practice/ End term Examinations)

COURSE CODE & NAME : 9402C- Automobile Technology Practical **TERM :** VI

S.NO.	NAME OF EQUIPMENT	No's
1	4 Stroke petrol engine - with all accessories	2 No's
2	4 Stroke Diesel engine - with all accessories	2 No's
3	Inline Fuel Injection Pump	2 No's
4	Injectors.	2 No's
5	Clutch set arrangement with tools	2 No's
6	Complete gear box with tools	1 No
7	Complete steering arrangement	1 No
8	Complete final drive and differential unit with tools	1 No
9	Alternator	2 No's
10	Starter motor	2 No's
11	Battery and charging set up.	1 No
12	Automobile Mechanic's tools, Internal circlip pliers, bearing puller, hammer and accessories Measuring instruments.	Complete Set
13	Consumables	Sufficient quantity

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9311& HVAC DRAWING AND CAD PRACTICAL
TERM: VI

S.NO	NAME OF THE EQUIPMENT	Nos
1	Personal computer	30
2	Printer	1
3	Required number of CAD package	30

1. A class room with 30 Drawing Tables.

2. Drawing instruments are given to each students at the beginning of the term as per requirements.

LIST OF EQUIPMENTS

(To accommodate a batch of 30 students in Practice / End Term Examinations)

COURSE CODE & NAME: 9404A DESIGN OF R&AC SYSTEM PRACTICAL TERM: VI

S.NO	NAME OF THE EQUIPMENT	Nos
1	Water cooled condenser test rig	1
2	Cooling tower test rig	1
3	Air cooled condenser test rig	1
4	Cooling load calculator package	1
5	Sheet metal fabrication tools	2 set
6	Reciprocating compressor, scroll compressor, evaporators, condensers	Each 2
7	Computerized automobile air conditioner test rig	1
8	Measuring instruments	Sufficient quantity
9	Tools, Safety Equipments	Sufficient quantity
10	Consumables	Sufficient quantity