

CERTIFICATE
OF
VOCATIONAL EDUCATION
EXAMINATION (YEAR-12)
SYLLABUS
MECHANICAL ENGINEERING
TECHNICIAN

Correspondence should be addressed to :-

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7. MECHANICAL ENGINEERING TECHNICIAN

SL. No	SUBJECT	CLASS XI	HOURS	MARKS	CLASS XII	HOURS	MARKS
1	English (COMPULSORY)	Paper I Paper II	1½ 1½	50 50	Paper I Paper II	1½ 1½	50 50
2	General Foundation Industrial Sociology & Entrepreneurship (Compulsory)	Paper I - Sociology Paper II - Environmental Education & Rural Development	3 3	50 50	Paper I - Complete Course Paper II - Entrepreneurship Project & Plan	3 3	50 50
3	Machinist Theory & Practice	Paper I - Theory Paper –II Practical	3 6-8	40 60	Machinist Theory & Practice Paper I- Theory Paper –II Practical	3 6-8	40 60
4	Technician Mathematics	Paper I -	3	100	Technician Mathematics	3	100
5	Geometrical Mechanical Drawing	Paper I -	3	100	Geometrical Mechanical Drawing	3	100
6	Engineering science	General Mathematics	3	100	Engineering science	3	100

MECHANICAL ENGINEERING TECHNICIAN

Aims:

On successful completion of the course, the technician should :

1. be aware of safety precautions which should be taken to ensure safe working conditions because of the hazards present in the workshop environment.
2. be able to select common hand tools and powered hand tools for a specific use.
3. be aware of the forms of supply and properties of materials both metallic and non-metallic (polymers) and reasons for corrosion protection.
4. know the processes involved in fabrication of components using both fusion and non-fusion methods of joining.
5. be able to lay out and mark jobs for production.
6. know the differences between measuring and gauging, their advantages, and the disadvantages, and the construction of handling precision measuring instruments for the assessment of length, flatness, roundness, squareness, angle and form.
7. know the importance of interchangeable manufacture and therefore a system of limits and fits in engineering.
8. have a knowledge of the following machines with regard to their mechanics, types, ranges, uses, attachments and safety.
 - i) Lathes
 - ii) Shaping machines
 - iii) Drilling machines
 - iv) Milling machines
 - v) Grinding machines
 - vi) Slotting machines
9. be familiar with single and multiple point cutting tools, cutting tools materials, advantages, disadvantages and applications with regard to speed, feed of tool, tool shape, and need for cutting fluids.
10. know the principles of heat treatment as applied to carbon steels and impact and hardness treating for the same.
11. have knowledge in sand castings, gravity and pressure die casting and compression transfer and injection moulding.
12. to give the students a feeling of being truly qualified Technicians and the confidence in handling mathematical relations and formulae and discovering for themselves their usefulness.
13. to develop a sound sense of degree of accuracy and of the uses and limitations and approximations.

ENGLISH LANGUAGE- Paper – I

CLASS XI AND XII DETAILED SYLLABUS

Objective : To provide experience of the structure and vocabulary of English to enable students to

1. Study other subjects in the curriculum
2. Develop communication skills for vocational purposes.

There will be two papers as follows:

Paper 1 (1½ hours)

Question One **Either**

(a) Candidate will be required to write a report in about three hundred words based on information provided.

OR

(b) Candidates will be required to write a passage of about three hundred words in the form of a description of events, or of a process, directions or instructions.

[Both types – (a) and (b) – will be set]

Question Two

Candidates will be required to write a letter from a choice of two subjects. Suggestions will be given. The lay-out of the letter with address, introduction, conclusion, etc., will form part of the assessment.

Question Three

An unseen passage of prose of about three hundred words will be given. Questions based on the passage will be of the objective type and will include multiple-choice answers, which may be verbal or diagrammatic. All questions will have to be answered. Questions will test the candidate's understanding of ideas expressed in the passage as well as the meaning of words and the function of structures.

Question Four

An unseen passage of about two hundred and fifty words will be given. A question or questions will be asked to test the candidate's ability to extract information from a passage. Candidates will be directed to provide the required information in the form of numerated notes, not in connected prose.

English – Paper II

1½ Hours

50 Marks

OBJECTIVE: To provide experience of a variety of English Prose, Poetry, Play, Addressing issues of human interest and concern.

Candidates are requested to answer five questions from the selected pieces. The question will be set to test the candidates ability to recall and respond to the information contained therein.

Question 1 will be compulsory, which will be set from the stories selected from Twelve Contemporary Short Stories. Another five questions will be set, one from each of the parts. i.e From Twelve Contemporary Short Stories, Poems, Essays, Excerpts of plays and from Great Modern Lives. Candidates are to answer any four out of the five questions. Total five questions to be answered.

Q1. Compulsory + Any four.

I. Twelve Contemporary Short Stories. (OUP)

- | | | |
|--------------------|---|-------------------------------|
| 1. Ruskin Bond | : | The Eyes Have It. |
| 2. Roald Dahl | : | Parson's Pleasure |
| 3. Jug Suraiya | : | Badger |
| 4. R.K. Narayan | : | Martyr's Corner |
| 5. Bernard Malamud | : | The First Seven Years |
| 6. Allen Seally | : | How Raj Kapoor Saved My Life. |

II. Poems

- | | | |
|---------------------------|---|----------------------|
| 1. Wystan Hugh Auden | : | The unknown Citizen |
| 2. David Herbert Lawrence | : | The best of School |
| 3. Robert Frost | : | The road not taken |
| 4. Edgar A Guest | : | It couldn't be done. |
- (The Art of Dynamic Thinking – Melvin Powers. Better yourself books)

III. Essays

1. J.B. Priestley : Too many people
2. E.R. Braithwaite : Job Hunting

IV. Excerpts from plays (Shakespeare)

1. Merchant of Venice
Prince of Arragon's Speech : "..... Who chooseth me shall get as much as he deserves"
2. Julius Caesar :
Mark Anthony's Speech : "Friends, Romans, Countrymen....."

V. 100 Great Modern Lives – Ed. John Canning (Rupa & Co.)

1. Douglas Collier : Jamshedji Tata
2. Andrew Ewart : Henry Ford.

**GENERAL FOUNDATION
AND
INDUSTRIAL SOCIOLOGY ENTERPRENEURSHIP**

Class XI (1st. Year) Theory 3hrs. 50 Marks Total 40 Hrs.

Paper I – Sociology

1.	Constitution of India	2 Hrs.
2.	Industrialization through five years plans.	2 Hrs.
3.	Industrial safety, First Aid and Hygiene & Safety Management.	2 Hrs.
4.	Population Education	3 Hrs.
5.	Unemployment and Automation	3 Hrs.
6.	Qualities of an Ideal Supervisor	1 Hr.
7.	Environmental Education	2 Hrs.
8.	Rural Development	2 Hrs.

Paper II – Environment Education & Rural Development. 3 Hrs. 50 marks

1.	1. Environmental Resources, Human Resources and Natural Resources.	2 Hrs.
	2. Population its impact.	1 Hr.
	3. Impact of industrialization on environment.	1 Hr.
	4. Effect of modern agriculture on environment.	2 Hr.
	5. Occupational Hazards.	2 Hr.
2.	Rural Development	5 Hrs
3.	Globalization	6 Hrs.
4.	Concerns Today	8 Hrs.

2nd. Year (XII) Paper I 50 marks 3 Hrs.

Paper I.

1.	1. Trade Union Act – 1926	
	2. Factories Act – 1948	
	3. Minimum Wages Act – 1946	
	4. Workmen’s Compensation Act – 1923.	
	5. Employees State Insurance Act – 1948.	
	6. Payment of wages Act – 1936.	
	7. Maternity Benefit Act – 1961.	
	8. Contract Labour Act – 1971.	
	9. Industrial Disputes Act – 1947.	
	10. Employees Provident Fund Act – 1952.	13 Hrs.
2.	a Entrepreneurship.	2 Hrs.
	b. All about small business including Indian Contract Act – 1872.	
	The sale of Goods Act – 1930.	3 Hrs.

- vi. Lifting weight
 - vii. Padders
 - viii. Fire
- b. Types of injuries and appropriate first aid
 - i. Severe bleeding
 - ii. Cessation of breathing
 - iii. Shock
 - iv. Poisoning
 - v. Drowning
 - vi. Fractures
 - vii. Burns
 - viii. Fainting
 - c. Safety Management.

4. POPULATION EDUCATION.

- a. Family Planning, small family norms, gender equality, female infanticide, Abortion laws / Euthanasia.
- b. Worker and his family – Love and Sex – Qualities of an ideal husband – Qualities of an ideal wife. Setting up a home.

5. UNEMPLOYMENT AND AUTOMATION

- i. Definition of unemployment
 - ii. Types of unemployment
 - a. Casual, seasonal, cyclical.
 - b. Technological, frictional.
- Automation and Computerization
- i. Tools that substitute hand.
 - ii. Machine that substitute muscles.
 - iii. Computers that substitute brains.

6. QUALITIES OF AN IDEAL SUPERVISOR

- 6.1 Be a part of the management
- 6.2 Be a leader of the workmen under you.
- 6.3 Be a policeman when needed
- 6.4 Knowledge of technical job.
- 6.5 Quality control and waste control.
- 6.6 Planning and scheduling.
- 6.7 Method of improvement.
- 6.8 Cost control.
- 6.9 Training your men.
- 6.10 Safety and first aid.
- 6.11 Working conditions of your men.
- 6.12 Problems in supervising women.
- 6.13 Wage payment.

- 6.14 Job evaluation
- 6.15 Merit rating
- 6.16 Labour laws.
- 6.17 Economics
- 6.18 Use of psychological tools.
- 6.19 Common sense
- 6.20 Cool and collective.

7. ENVIRONMENTAL EDUCATION

1. Environmental resources (energy, air, water, soil, minerals, plants, animals), carrying capacity, effects of exploitation.
2. Population explosion and incompatibility between resources and number, demands on environment to meet 'basic human needs' and 'aspiration of more ambitious goals, its effect on environment'.
3. Impact of industrialization on environment:
 - 3.1 Irreversible changes in landscape.
 - 3.2 Encroachment / degradation of environment and its effects.
4. Effects of modern agriculture on environment:
 - 4.1 Use of high-yielding varieties and deprivation of genetic resources.
 - 4.2 Canal irrigation and water logging.
 - 4.3 Use of fertilizers and pesticides and its effects on environment.
 - 4.4 The dangers in manufacturing, storing, transporting, disposing of insecticides.
5. Land use, soil degradation, population pressure and depletion of forests, grassland and cropland.
6. Environment pollution of air, water and soil and its effects on the living world.
7. Hazardous industrial and agricultural products:
 - 7.1 Safety and health risks connected with their use,
 - 7.2 Impact on environment when used.
8. Misuse of medical technology: the drug menace.
9. Properties of materials (bio-degradable & non-degradable)
10. Typical environmental problems
 - 10.1 Deforestation
 - 10.2 Desertification
 - 10.3 Landslides
 - 10.4 Silting and drying of water resources.
 - 10.5 Pollution of lakes and waterways.
 - 10.6 Toxic substances
11. Occupational hazards
 - 11.1 Organizational risks.
 - 11.2 Equipment related risks.

- 11.3 Process related risks.
- 11.4 Product related risks.

12. Environmental action

- 12.1 Environmental protection and conservation of resources.
- 12.2 Pollution control, environmental pollution laws and regulations.
- 12.3 Waste disposal.
- 12.4 Desirable nutrition and sanitation practices.
- 12.5 Recuperation, recycling and substitution.
- 12.6 Community action for ecological restoration, social and agro forestry.
- 12.7 Economic use for resources (material, energy, money, time)
- 12.8 Living in harmony with nature, the environmental ethics.

13. Occupational safety

- 13.1 Fire safety
- 13.2 Safe handling of equipment and materials.
- 13.3 Safety precautions in lab/workshop/work site.
- 13.4 First aid.
- 13.5 Safety management.

8. RURAL DEVELOPMENT.

1. Land use profile in India
2. Causes of economic backwardness: the 'poverty trap'
3. Measures to increase agriculture productivity by improving the inputs.
4. Afforestation – social and farm forestry (environmental, social and economic enhancement).
5. Rural waste re -cycling-biogas plant, compost making.
6. Provision of basic health services for the community – provision of medical care, improvement of environmental sanitation, control of communicable diseases, mother and child health care, school health services. Development of desirable health, nutrition and environmental sanitation practices in the community.
7. Activization of agencies responsible for rural development.(Integrated Rural Development Programme. Small Farmers Development Agency, etc.)
8. Innovations and Development of Rural Industries.

ENVIRONMENTAL EDUCATION AND RURAL DEVELOPMENT

Class XI

Theory 3 Hrs.

Marks – 50

Sociology – Paper – II

1. i. Environmental Resources (energy, air, water, soil, minerals, plants & animals)
- ii. Population – Human resources and Natural resource. Exploitation and Exploration of natural resources. Conservation of natural resources waste products management. Respect for laws regulating Community living. Respect for others freedom. Concern for public property.
- iii. Impact of industrialization on environment.
 - a. Irreversible change in landscape.
 - b. Encroachment / degradation of environment and its effects.
- iv. Effect of modern agriculture on environment.
 - a. Effect of high-yielding varieties and deprivation of genetic resources.
 - b. Canal irrigation and water logging.
 - c. Use of fertilizers and pesticides and effect.
 - d. The dangers in manufacturing, storing, transporting, disposing of insecticides.
- v. Land use, soil degradation , population pressure and depletion of forest grasslands and cropland.
Environment pollution of air water and soil and its effect on the living world.
- vi. Measure of medical technology the drug abuse.

- vii. Biodegradable and non-degradable materials.
 - ix. Typical environmental problems. Deforestation, Desertification,
 - x. Landslides, silting and drying of water resources, pollution of lakes and resources, toxic substances.
- ix. Occupational Hazards
 - a. Organizational risks
 - b. Equipment related risks.
 - c. Process related risks.
 - d. Product related risks.
2. Rural development (with reference to the 20-point programme, 1986)
- a. Land use profile in India.
 - b. Causes of economic backwardness, the poverty trap.
 - c. Measures to increase agriculture productivity by improving the inputs.
 - d. Afforestation – social and farm forestry. (environmental, social and economic enhancement)
 - e. Rural waste recycling – bio gas plant, compost making.
 - f. Provision for basic health service for the community – medical care, environmental sanitation, communicable diseases, mother and child health care, school health service.
Development of desirable health, nutrition and environmental sanitation practices in the community.
 - g. Activisation of agencies responsible for rural development. (Integrated rural development programme IRDP, small farmers development agency, marginal farmer’s development agency.
 - h. Innovation and development of rural industry.
3. Globalization.
- a. Globalization as a worldwide aspiration linking human values.
 - b. Modernism and Internationalism.
 - c. Global broadcasting and journalism, role of news agencies, effects of the global reach of broadcasting, risk to cultural values due to bombardment of foreign base media.
4. Concerns today.
- a. Nuclear disarmament - CTBT
 - b. Human rights, Gia hypothesis, Malthusian theory, Darwinism & Frances Galton and the Eugenists.
 - c. Consumer and the competitive market.
 - d. Dehumanization due to technological advances.
 - e. Advertising and its impact.
 - f. Impact of society moving towards quick fix solutions leading to corrupt practices.
 - g. Underemployment and unemployment.
 - h. The ethical and the moral impact of the Internet.

- i. Reaching out : Types of communication networks and their utilities –e-mail, facsimile, video conferencing, understanding of the internet as a global knowledge base and communication network.

**GENERAL FOUNDATION &
INDUSTRIAL SOCIOLOGY
ENTERPRENEURSHIP**

Class XII

Paper – I

Part – A Compulsory objective type of questions covering the entire syllabus of class XI and class XII carrying 20 marks.

Part – B Will have 8 questions covering labour legislation and entrepreneurship, Building people & Science Technology of which candidates will have to answer 6 questions carrying 5 marks each = 30 marks.

Paper – II Will be of 3 hrs consisting of a complete project plan, preparations of a feasibility certificate and registration – 50 marks.

Paper I 3 Hrs. Marks - 50.

1. **The Trade Union Act - 1926**

- a. Trade union
- b. Registration
- c. Various rules and regulations.
- d. Cancellation of Registration.

- e. Rights and duties of Trade union.
2. **Factories Act – 1948.**
- 1. Definitions of adult, adolescent, young person, manufacturing process worker, factory, occupier.
 - 2. Scope :- applicable to
 - a. Establishment with 10 or more workers – work with the aid of power.
 - b. 20 or more workers without the aid of power.
 - c. Establishment not in accordance with the above two cases but notified by the Government.
 - 3. Main provisions
 - i. Health, safety, welfare
 - ii. Hours of work
 - iii. Employment of young persons and women
 - iv. Annual leave with wages
 - v. Occupational diseases
 - vi. Administration
 - vii. Enforcement
 - viii. Penalties for offences.
- 4.. **Minimum wages Act, 1948.**
- i. Living wage, Fair wage, Minimum wage & subsistence wage.
 - ii. Scope
 - iii. Salient features
 - a. Minimum time rate of wages
 - b. Minimum piece rate
 - c. A guarantee time rate
 - d. Overtime rate.
 - iv. Provisions
 - a. Payment in cash
 - b. Cost of living
 - c. Maintaining records
 - d. Violation and enforcements.
 - v. **Workmen’s compensation Act – 1923**
 - a. Objectives – imposition of compensation.
 - b. Scope – Certain category of railway men
 - c. To all wage earners earning up to Rs.1000/- per month in certain notified establishments.
 - d. For death, permanent total disablement, permanent partial disablement, Temporary disablement.
5. **Employees State Insurance Act 1948.**

- i. Objectives - Benefits to employees in case of sickness, maternity, disablement, dependents, employment injury.
- ii. Scope – Applies to all non-seasonal factories, shops, hotels, restaurants. Not applicable to men of armed forces and those drawing above Rs.5,000/- per month.
- iii. Finance - Employees contribution – 2½ %
- Employer's contribution – 5 %
Those drawing less than Rs.6/- per day are exempt from contribution.

6. **Payment of Wages Act – 1936.**

- i. Objectives – To ensure wages for employees drawing less than Rs.1600/- per month.
- ii. Provisions :
- iii.
 - i. State Government to enforce.
 - ii. Fixation of wages periods
 - iii. Deductions :
 - iv. Fines
 - v. Absence from duty
 - vi. Damages, Loss
 - vii. House / Accommodation
 - viii. Advances or over payment
 - ix. Income Tax societies.
 - x. Co-operative
 - xi. Insurance premium
 - xii. Levy on mines.

7. **Maternity Benefit Act - 1961**

- i. Objective – To regulate employment of women in certain establishment for certain period before and after child birth.
- ii. Scope – Applies to factories, mines, circus, industries, plantations and Government establishment.
- iii. Provisions – Eligibility conditions, period for benefit paid, rate of benefit.

8. **Contract labour Act – 1970.**

- i. Object – To regulate the employment of contract labour.
- ii. Scope – Applies to establishment in which twenty or more workers are employed or were employed on any day of the preceding 12 months as contract labour to every contractor who employs or who employed on any day of the preceding twelve months, twenty or more workers.
- iii. Terms – Contractor, Establishment
- iv. Main provisions.
 - a. Setting up of advisory Boards
 - b. Registration of establishments
 - c. Welfare and health of contract labour
 - d. Penalties and Procedures.

9. **Industrial Disputes Act – 1947.**

- i. Definition of industrial disputes.
- ii. Machinery set up by the Act.

- iii. Labour court, Board of enquiry, Industrial tribunal, Conciliation
 - iv. Adjudication
 - iv. Employees Provident Fund Act – 1952.
Object & Scope – Applied to all factories and establishments and notified industries employing 20 or more people.
 - i. Rate of contribution
 - ii. Protection from attachment
 - iii. Membership
 - iv. Family pension scheme
 - v. Benefit of the scheme.
 (The latest amendments to the Act must be taken into consideration)
- 11. Entrepreneurship
- 12. All about small business.
 - i. Small Business
 - ii. Need for small business
 - iii. Economic Contribution
 - iv. Possible types of business
 - v. Employer and labour relation
 - vi. Buyer and seller relation
 - vii. Incentives in certain areas
 - viii. Assistance from District Industries Center.
 - ix. Assistance from small scale industries.
 - x. Service industries.
 Managerial Qualities of an Entrepreneur
 - i. Should be confident
 - ii. Should be dynamic
 - iii. Should be creative
 - iv. Should be able to take initiative
 - v. Should be flexible
 - vi. Should be result oriented
 - vii. Should be energetic and hard working
 - viii. Should be far sighted
 - ix. Should accept challenges
 - x. Should be able to communicate effectively.
 - xi. Should be aware of ancillary development.
- 13. Estimating and costing.
- 14. Project planning & project report making.
Indian Contract Act – 1872.
 - i. Definition of contract, offer, acceptance, performance of contract.
 - ii. Indemnity and Guarantee.
 - iii. Different kinds of agents.
 The sale of Goods Act – 1930
 - i. Definition of Buyer, Seller, Delivery Goods.
 - ii. Price
 - iii. Formation of the contract sale.
 - iv. Difference between sale & hire purchase.

15. Building People.
 - i. Privatization v/s Nationalization
 - ii The need for governments to govern and leave economic activities to the people, Role of NGOs.
 - iii Generation of financial resources to meet governmental expenses.
 - iv Impact of privatization on economic development with specific reference to Insurance, Telecommunications, Railways and Electricity.

16. Science & Technology.
 - i. Animal and human aggression
 - a. Human and non-human signals of aggression.
 - b. Weapons devised by man for offence and defence.
 - c Nuclear weapons, control on weapons manufacture, sale of foreign power.
 - d. Technology – does it make war more or less likely?

 - ii. Science and Technology as change agents
 - a. Affect of scientific developments on our lives – at work and at home.
 - b. Business on net – e- commerce, its feasibility and implications.

 - iii. Cosmology and space research
 - a. Current theories about the origins of the universe.
 - b. Probability of existence of Extra Terrestrial Intelligence.
 - iv. Emergence of new technologies their appreciation
 - a. Non-Digital and Digital technology.
 - b. Communication technology.
 - c. Information technology.

ENTREPRENEURSHIP PROJECT PLAN PAPER – II

3 Hrs.

CURRICULUM IN ENTREPRENEURSHIP DEVELOPMENT

Entrepreneurship curriculum is divided into five major modules:

1. Entrepreneurial career orientation.
2. Entrepreneurial spirit (values and attitudes) and behavioural competencies.
3. Entrepreneurial motivation.
4. Enterprise launching competency.
5. Enterprise management competencies.

1. ENTREPRENEURIAL CAREER ORIENTATION

Today, most prevalent and commonly pursued career after education is that of a wage earner. The great potential of self-employment and the incentives thereof are not well known. This information, orientation and necessity related to future career option will orient students to entrepreneurial career.

2. ENTREPRENEURIAL SPIRIT AND BEHAVIOURAL COMPETENCIES.

Entrepreneurial spirit consists of values and attitude. Since value provides the direction and attitude decides the tendency to act in a given situation, certain competencies are needed to actually take action governed by values and attitudes. These competencies will help students in entrepreneurial career.

3. ENTREPRENEURIAL MOTIVATION

Force, drive and energy are needed to pursue the path of entrepreneurial career. Since forces are provided by creating an urge in the individual for efficiency that reflects through competition with other or with one's standards of performance, the total process is termed as entrepreneurial motivation.

4. ENTERPRISE LAUNCHING COMPETENCY

This includes competencies related to sensing opportunities; project/product; project formulation availing incentives; resource mobilization and finally launching the enterprise.

5. ENTERPRISE MANAGEMENT COMPETENCIES

The enterprise may be small or big but it demands management abilities in its own manager. The various management functions such as production, marketing, finance, etc., are crucial functions for entrepreneurs. This module will help students in developing enterprise management competencies.

MACHINIST - THEORY AND PRACTICE

Paper 1: Machinist Theory - 3 hrs - 40 marks

This paper will have two sections .

Section A (objective type) – 36 marks. All the questions will be compulsory.

Section B (64 marks) This section will consist of 10 question and the candidates are expected to answer any 8 .

Class - XI Theory 3 Hours 40 marks
1. SAFETY

- i. Identify hazardous conditions in a workshop environment including those which require the use of protective clothing and equipment.
- ii. State the specific need for eye protection under workshop conditions.
- iii. Identify the dangers associated with flammable materials in the workshop.

- iv. State the reasons for the correct marking handling and storing of gas cylinders.
- v. Identify the dangers associated with the use of electricity in the workshop .
- vi. State common methods for stopping equipment in an emergency and making it safe.
- vii. Identify the reasons for adequate ventilation in processes involving noxious fumes.
- viii. Identify the dangers associated with the use of compressed air in the workshop.
- ix. State the need for guarding equipment which has moving parts.
- x. Identify the dangers associated with unsuitable clothing and loose hair when working with equipment which has moving parts.
- xi. State the dangers associated with the presence of dust and sparks in industrial processes.
- xii. State the need for protection of the skin against irritants.
- xiii. State the correct procedure for mounting machine.

2. USES OF COMMON HAND TOOLS

- i. Identify common hand tools.
- ii. State the care necessary to maintain hand tools in good condition.
- iii. State the care necessary to store hand tools properly.
- iv. Select appropriate hand tools to perform basic tasks.
- v. Select the appropriate equipment for holding the work while performing basic tasks.
- vi. Select appropriate powered hand tools to perform basic tasks.
- vii. List the relative merits and limitations of both powered and non-powered hand tools in terms of speed of production, cost, accuracy and fatigue caused to the operator.
- viii. Recall the need for bending and folding allowances for simple developed shapes and minimum bending radii.
- ix. Select appropriate hand tools and manually operated folding machines and guillotines to produce basic shapes.
- x. List the sequence in which manually operated tools should be used for the manufacture of simple components.

3) FORMS OF SUPPLY AND PROPERTIES OF MATERIALS

- i. Use catalogues, lists and tables to identify and select materials for specific uses.
- ii. Identify engineering materials as being either metallic or non-metallic.
- iii. Identify metals as being either ferrous or non-ferrous .
- iv. Describe (in simple outline form) the primary casting process for the production of raw materials for rolling and forging, i.e. ingots, blooms and billets.
- v. State the forms of supply of the raw materials for forging, casting extruding drawing and rolling.

- vi. State the special properties required of the raw material used in the primary forming process.i.e. fluidity, plasticity, ductility and malleability
- vii. Describe with the aid of sketches, the hot and cold rolling processes to produce bars, sections and plates.
- viii. Describe, with the aid of sketches the process of forging extrusion and drawing for the production of components and sections.
- ix. State the special characteristic, advantages and limitations of metals and components produced by the primary forming processes.
- x. Select suitable primary forming processes for the production of simple specified components.
- xi. Identify the materials cast iron, plain carbon steels, copper tin, zinc, lead, aluminum, plastics and laminates.
- xii. State in general terms the physical properties of the materials specified in 3.11 thermal conductivity, electrical conductivity, melting point and density.
- xiii. State in general terms the mechanical properties of the materials specified in3.11 Plasticity, Malleability, Toughness, Strength, Brittleness, Hardness and Elasticity.
- xiv. State typical compositions, properties and uses of low, medium and high carbon plain steels and cast iron.

4) MARKING OUT

- i. State the reasons for making out components.
- ii State that the function of a surface plate is to serve as a datum and reference plane.
- iii State the function of datum planes and datum lines, center lines and datum holes.
- iv Select basic marking out equipment for simple tasks, i.e. marking blue, chalk, straight edge, dividers, rule, scribe, centre punch, try square, vee blocks, surface height gauge.
- v. State where templates can be used in engineering, i.e. in fabrication, machining and inspection, and state why they are used.

5) MEASUREMENT AND GAUGING

- i. State the difference between gauging and measuring.
- ii. State the uses of end and line standards.
- iii. Explain the need for a standard of measurement.
- iv. State the accepted workshop standards for length, flatness, straightness and squareness
- v. Explain the use and care of common measuring instruments, gauges and workshop standards and their accessories

- vi. Describe, with the aid of illustrations, tests for roundness and linearity using a dial test indicator.
- vii. Describe the procedure for checking flatness using engineer's blue and surface plate.
- viii. State the importance of points of support for straight edges and end standards.
- ix. State the principles and explain the construction of the micrometer.
- x. State the uses of external, internal and depth micrometers and their degree of accuracy.
- xi. Explain the principle of a vernier.
- xii. State how to use calipers, height gauges, depth gauges and protractors with vernier scales and state the degree of accuracy of these instruments.

6 MACHINE TOOLS

- i. Compile block diagrams to show the power transmission from the input to the work and the cutting tool of the centre lathe and drilling machine.
- ii. Compile line diagrams and describe the relative tool-to-work movements & the resulting geometrical shapes produced by the machines detailed in 6.1.
- iii. Draw typical shapes produced by a combination of generating and forming.
- iv. Sketch and describe the following as applied to machine tool systems.
 - a. Slideways
 - b. Screw and nut movements.
- v. List the logical order, the sequence of processes for the manufacture of simple components using the machines detailed in 6.1

7. CUTTING TOOLS

- i. Identify rake and clearance angles on common cutting tools.
- ii. State the uses of twist drills and reamers.
- iii. Identify methods of holding and driving twist drills and reamers.
- iv. Explain the effect on the drilling process on the holes produced using incorrectly ground drills.
- v. For turning operations, explain
 - a. the reason for correct tool setting with regard to height
 - b. the need to achieve maximum rigidity in tool setting
- vi. State the composition of a typical high-speed steel.
- vii. Make a simple assessment of the advantages and limitations of high-carbon steel, high

- speed and cemented carbides as cutting tool materials.
- viii Select appropriate rates of speed and feed for given cutting operations.
 - ix. Determine the appropriate machine spindle speed from a given cutting speed of material.
 - x State the effect of the rate of feed and tool nose geometry on surface texture.
 - xi State the effect of variations in speed, feed and depth of cut on cutting force, power consumption and tool life.
 - xii Compare the advantages and limitations of solid tool construction, tipped tools and inserts.
 - xiii. State the characteristics of cutting fluids including their cooling and lubricating properties and their effects on the cutting process.
 - xiv. Select and justify the use of a suitable cutting fluid for a particular machining operation.

MACHINIST - THEORY AND PRACTICE

CLASS XII THEORY 3 HOURS Full marks-40

FORMS OF SUPPLY AND PROPERTIES OF MATERIALS

- i. State the forms of supply, application, properties and uses of typical thermoplastic and thermosetting plastic.
- ii. Describe hot bending techniques for forming plastic materials.
- iii. State the form of supply of the raw materials for compression, transfer and injection moulding & other plastic manufacturing processes.
- iv. Compare common plastics and metallic materials with regard to strength, rigidity, electrical conductivity, temperature stability and ease of production.
- v. State typical compositions, properties and uses of carbon/tin and copper/zinc alloys.

- vi. State the forms of supply, application, properties and uses of aluminium alloys.
- vii. State typical compositions and properties and use of tin/lead soldering alloys.
- viii. State the properties of phosphor bronze, cast iron and PTFE, which make them suitable as bearing materials.
- ix. State the need for protection of certain metals from corrosion.
- x. Describe the methods of corrosion prevention.

2. FABRICATION

- i. Describe how primary formed materials can be joined for forming a fabrication, using permanent and/or non – permanent joining techniques.
- ii. Make simple comparisons between the forming processes of casting and forging with fabrication and joining in terms of equipment used and ease of manufacture.
- iii. State the relative advantages of mechanical non fusion and fusion methods of joining.
- iv. Identify the types of adhesive in general use for soldering and brazing.
- v. Identify the types of adhesive in general use for joining metallic and non metallic materials.
- vi. State, with the aid of sketches, the principles of basic gas and electric arc welding processes.

3. MEASUREMENT AND GAUGING

- i. Identify typical applications of plunger & lever types of dial test indicators & their accessories.
 - ii. State the meaning of 'tolerance' and limits of accuracy.
 - iii. Describe, with the aid of sketches, the use and care of plain plug, gap and plain ring gauges.
 - iv. State Taylor's principle and its application to the limit gauges in 3.3.
 - v. State the advantages and limitations of gauging as a method of inspection.
 - vi. State the principles and use of the sine bar.
 - vii. Make the necessary calculations for the use of a sine bar.
- viii. Explain why surface texture may be an important feature on engineering components.
- ix. Distinguish between the different surface textures produced by common machining processes.

4. INTERCHANGEABLE MANUFACTURE

- i. State the reasons for adopting a hole-based system of limits and fits.
- ii. Define the three classifications of fit.
- iii. Determine value from the appropriate British Standard for a given size and fit of shaft and hole.
- iv. Relate manufacturing processes to tolerance grades.
- v. Determine maximum and minimum metal limit conditions for a given example of fit.
- vi. State the advantages and limitations of interchangeability and selective assembly.

5. MACHINE TOOLS

- i. Compile block diagrams to show the power transmission from the input to the work and the cutting tool of milling machine, shaping machine and surface grinding machine.

- ii. Compile line diagrams and describe the relative tool-to-work movements, and the resulting geometrical shapes produced by the machines detailed in 5.1.
- iii. Draw typical shapes produced by combination of generating and forming.
- iv. Sketch and describe the following as applied to machine tool systems.
 - a) Slideways
 - b) Screw and nut movements.
- v. List in logical order, the sequence of processes for the manufacture of simple components using the machines detailed in 5.1.

6 CUTTING TOOLS

- i. State the composition of a typical high-speed steel.
- ii. Make a simple assessment of the advantages and limitations of high-carbon steel, high speed steel and cemented carbides as cutting tool materials.
- iii. Select appropriate rates of speed and feed for given cutting operations.
- iv. Determine the appropriate machine spindle speed from a given cutting speed of material.
- v. State the effect of the rate of feed and tool nose geometry on surface texture.
- vi. State the effect of variations in speed, feed and depth of cut on cutting force, power consumption and tool life.
- vii. Compare the advantages and limitations of solid tool construction, tipped tools and inserts.
- viii. Apply the terminology of tool geometry to milling cutters.
- ix. State the principles of metal cutting in milling and grinding.
- x. Sketch and describe the following types of solid milling cutters, end mill, slot drill, face mill, side-and-face cutter, slab (barrel) mill and angle cutter.
- xi. Define up-cut and down-cut milling and state the merits and limitations of each process.
- xii. Illustrate and name the following features of grinding wheel, grit, bond and void.
- xiii. State the effect of type and size of grit and bond on the cutting action of a grinding wheel.
- xiv. Explain how a grinding wheel achieves a self sharpening effect.
- xv. Describe how grinding wheel may be dressed by diamond or by star wheels.
- xvi. State the characteristics of cutting fluids including their cooling and lubricating properties and their effects on the cutting process.
- xvii. Select and justify the use of a suitable cutting fluid for a particular machining operation.

7 HEAT TREATMENT

- i. Draw a simplified iron-carbon equilibrium diagram (0° to 1000°c and 0% to 1.5% carbon) and indicate the zones for 'ferrite', 'pearlite', 'austenite' and 'cementite'.
- ii. State the reasons for annealing normalizing, hardening and tempering.
- iii. State the procedures of annealing, normalizing, hardening and tempering a steel of given carbon content and relate these processes to the iron-carbon equilibrium diagram.
- iv. State the reasons for case hardening.
- v. List the procedures adopted for case hardening by pack, salt bath and gaseous methods.
- vi. Select the appropriate heat treatment process, given the composition of a plain carbon steel and the properties required.
- vii. Define the terms hardness and toughness.
- viii. Describe two hardness tests
 - a. One using hardness steel ball,
 - b. One using a diamond indenter.
- ix. State the principles of operation of the Izod or the Charpy test
- x. Describe the principles of operation, simple construction and application of the thermocouple pyrometer, the mercury-in steel thermometer and the optical pyrometer.
- xi. Compare the advantages and limitations of the instruments in 7.10.
- xii. Sketch, name, locate and describe the function of the main features of muffle, non muffle and salt bath furnaces, electric furnaces.
- xiii. Recognize the importance of using controlled atmosphere heat treatment in the avoidance of oxidation.
- xiv. Compare the advantages of limitations of air, oil, water and brine as cooling media.

8 MOULDING AND CASTING PROCESSES

- i. Describe, with the aid of sketches, the principles of gravity die-casting.
- ii. Describe simply, with the aid of sketches, the principles of pressure die-casting.
- iii. Describe simply, with the aid of sketches, the process involved in compression, transfer and injection moulding of plastic materials in common use.

9A C N C MACHINES AND MANUFACTURING SYSTEMS

- i. Advantages of C N C machines.
- ii. C N C machining centre developments
- iii. Turning centre developments
- iv. Tool monitoring on C N C machines.

- v. Other C N C developments (C N C grinding, C N C sheet metal working machines, C NC gear cutting)
- vi. Advanced Manufacturing systems.
- vii. Benefits of a Flexible Manufacturing system.

9B DESIGN OF MODERN CNC MACHINES AND MECHATRONIC ELEMENTS

- i. Machine structure.
- ii. Compare the advantages and limitations of the common types of guide ways in use on C NC machines.
 - a. Friction guide ways
 - b. Vee guide ways
 - c. Flat and dove tail guide ways
 - d. Cylindrical guide ways
 - e. Anti friction linear motion guide ways
 - f. Hydro static and Aero static guide ways
 - g. Feed Drives
 - g. Servomotor
 - h. Mechanical transmission systems
 - (i) Recirculating ball screws
 - (ii) Roller screws
 - (iii) Rack and pinion
- iii. Spindle/Spindle bearings, compare the advantages and limitations of
 - a. Hydrodynamic
 - b. Hydrostatic and
 - c. Anti friction bearings in relation to spindle support.
- iv. Measuring systems
 - a. Direct measuring system
 - b. Indirect measuring system
 - c. Incremental rotary encoders
 - d. Linear scale.
- v. Controls, software and user interface
- vi. Gauging principles for

- a. work piece inspection
- b. defining tool offsets
- c. tool breakage detection
- d. work piece presence detection
- e. automatic alignment of work piece
- f. detection of stock variation.

9C PROGRAMMING AND OPERATION OF C NC MACHINES

- i. Introduction to part programming
- ii. Co ordinate system
- iii. Dimensioning
- iv. Axes and motion Nomenclature
- v. Structure of a part programme
- vi. Word Addressed Format
- vii. G02/G03 circular interpolation
- viii. Tool Compensation
- ix. Subroutines (Macros)
- x. Canned Cycles (G81 – G89)
- xi. Mirror image
- xii. Parametric programming (user Macros) and R- parameters
- xiii. G96 S..... Constant cutting speed and G97 constant speed
- xiv. Machining Cycles.

9D SELECTING TOOLS

- i. Using catalogues, lists and tables to choose the best tool for a particular operation – whether turning, milling or Drilling on a C N C machine.
- ii. Demonstrate an awareness of cutting tool materials in use on C N C turning and machining centres.
 - a. Tungsten Carbide
 - b. Titanium Carbides/Nitrides
 - c. Nitride Ceramics
 - d. Polycrystalline diamond
 - e. Cubic Boron Nitride.

FUNDAMENTAL PRINCIPLES OF INDUSTRIAL PRIME MOVERS

- i. The Hydraulic system (Fundamental principles)

- ii. Types of Hydraulic pumps
 - a. Gear pumps
 - b. Vane pumps
 - c. Piston pumps
 - d. Combination pumps.
- iii. The pneumatic system (Fundamental principles)
- iv. Compressor types
 - a. Piston compressors
 - b. Screw compressors
 - c. Rotary compressors
 - d. Dynamic compressors.

Paper 2

Practical

6-8 hours

60 marks

Students will be given practical training on all topics related to Machinist theory. The practical examination will consist of an actual practical test and a written paper which shows the sequence of operations to be followed by the candidate .The Practical test will consist of a job or jobs (assembly) for which a detailed dimensioned figure will be provided to test the students ability to select the right machine (or) machines and follow in correct sequence the steps to turn out the finished product or assembly to the given tolerances within the time limit.

The actual practical work will carry 70% of the marks.15% will be for the written paper and 15% for the practical work done during the course period(which will be internally assessed).

TECHNICIAN MATHEMATICS

CLASS XI PAPER 1: General Mathematics - 3 Hours - 100 Marks

General Mathematics, consisting of **FOURTEEN QUESTIONS** on:

- 1 Arithmetic
- 2 Algebra
- 3 Trigonometry

Candidates will be required to answer **TEN QUESTIONS**.

1) ARITHMETIC

- 1.1. Logarithms and Logarithmic expressions: Common and natural.
 - 1.1.1 Define a logarithm to any base.
 - 1.1.2 Convert a simple indices relationship to a logarithmic relationship and vice versa.
 - 1.1.3 Deduce the laws of logarithms in the following terms where b is any base.
$$\text{Log}_b (MN) = \log_b M + \log_b N$$
$$\text{Log}_b (M/N) = \log_b M - \log_b N$$
$$\text{Log}_b (N^a) = a \times \log_b N$$
 - 1.1.4 State the $\log_b 1 = 0$, $\# \log_b = 1$
 - 1.1.5 State that as $x > 0$, $\# \log_b x > (-)$
 - 1.1.6 Apply the laws of logarithm to simplify equations.
 - 1.1.7 Apply the laws of logarithms to solve equations.
 - 1.1.8 Define the natural base as approximately 2.718.
 - 1.1.9 Define natural (Napierian) logarithms ($\log_e M$ or $1 M$)
 - 1.1.10 Determine natural logarithms from tables and by calculator.
 - 1.1.11 Evaluate expressions and solve equations involving natural logarithms.
 - 1.1.12 Deduce the relationship between natural and common logarithms.
- 1.2 Indicial Equations
 - 1.2.1 Change the base of numbers using the law of powers, e.g. $16 = 4^2$. $27 = 3^3$
 - 1.2.2 Change the base of numbers where the index may be in algebraic form such as $8^x = 2^3 x$.
 - 1.2.3 Solve indicial equations where the indices are linear in one unknown.
 - 1.2.4 Solve indicial equations where the indices are quadratic in form in one unknown.
- 1.3 Mensuration
 - 1.3.1 Areas and perimeters of common plane figures.
 - 1.3.2 Surface areas, volumes and masses of common regular solids of prismatic and cylindrical shapes.
 - 1.3.3 Surface areas, volumes and masses of common regular solids of pyramidal, conical and spherical shapes.
 - 1.3.4 Areas of irregular figures using the mid-ordinate rule.

2) ALGEBRA

2.1 Formulae and laws

The evaluation of formulae and expressions, with or without the use of a calculator.

2.1.1. Determine a logical sequence of steps to evaluate an expression containing at least two variables/constants

e.g. ax^b , ab^x , $(a + x)^n$ with and without the use of calculator.

2.1.2 Draw up a table of values by carrying out repeated calculation from an equation or formula for different values of the variable.

2.1.3 Transpose formulae in which the subject is contained in more than one term e.g.

$$\sqrt{\quad} T = 2\pi \frac{1}{g} \quad \text{for } l, A = \pi r^2 \quad \text{for } r$$

2.1.4 Transpose formulae in which the subject is contained in more than one term, e.g.

$$1 = \frac{IR}{R + r} \quad \text{for } R$$

2.1.5 Check computed values, e.g. by an alternative sequence or by backwards substitution.

2.1.6 Demonstrate the effects of rounding and truncation errors.

2.2 Simple quadratic equations

2.2.1 Recognize factors of quadratic expressions, including $(a + b)^2$, $(a - b)^2$ and $(a^2 - b^2)$

2.2.2 Factorize quadratic expressions, including perfect squares and the difference of two squares.

2.2.3 Recognise that some simple quadratic expressions do not factorise e.g. $(a^2 + b^2)$.

2.2.4 Define the roots of an equation.

2.2.5 Determine the equation which is satisfied by a given pair of roots.

2.2.6 Recognise a quadratic expression, a quadratic equation.

Solve quadratic equations with real roots by factorization.

Solve quadratic equations which provide real roots by the use of the formula

$$x = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$$

2.2.7 Form and solve quadratic equations which are mathematical models of practical problems, e.g. linear accelerated motion, second order chemical reaction.

2.2.8 Check a solution of the equation by substitution, disregarding irrelevant roots.

2.2.9 Solve algebraically simultaneous quadratic and linear equations.

2.3 Points of intersection of two graphs and their significance

2.3.1 Solve a pair of simultaneous equations in two unknowns graphically.

- 2.3.2 Determine the roots of a quadratic equation by the intersection of the graphs with the X-axis
- 2.3.3 Solve a simultaneous linear and quadratic equation by the intersection of their graphs.
- 2.3.4 Plot the graph of a cubic equation with specified interval and range.
- 2.3.5 Solve a cubic equation using 2.3.4
- 2.4 Graphs of exponential growth and decay
- 2.4.1 Plot the graphs of $y = e^{ax}$ and $y = -ax$ with the aid of tables and with the aid of a calculator.
- 2.4.2 Draw graphs of experimental data of growths and decays which are exponential functions.
- 2.4.3 Define the gradient of any curve at a point as the tangent at that point.
- 2.4.4 Determine gradients of the curves in 2.4.1 and 2.4.2 and verify that these gradients are proportional to the relevant ordinates.
- 2.5 Complex Numbers
- 2.5.1 Definitions
- 2.5.2 Power of j
- 2.5.3 Addition and subtraction of complex numbers in algebraic form.
- 2.5.4 Multiplication of complex numbers in algebraic form
- 2.5.5 Conjugate complex numbers
- 2.5.6 Division of complex numbers in an algebraic form
- 2.5.7 The Argand Diagram
- 2.5.8 The j-operator
- 2.5.9 Addition of phases
- 2.5.10 Subtraction of phasors
- 2.5.11 The polar form of a complex number.
- 2.5.12 Multiplying numbers in polar form.
- 2.5.13 Square root of a complex number.
- 2.5.14 Dividing numbers in polar form.

3) TRIGONOMETRY

- 3.1 Some properties of trigonometric functions.
- 3.1.1 Sketch a sine wave over one complete cycle by relating the angle of a rotating unit radius to the vertical projection .
- 3.1.2 Sketch a cosine wave over one complete cycle by relating the angle of a rotating unit radius to the horizontal projection.
- 3.1.3 Determine values of the Trigonometric ratios for angles between 0° and 360° .
- 3.1.4 Define $\tan A = \frac{\sin A}{\cos A}$ and sketch the graph of $\tan A$ as A
Varies from 0° to 360° .
- 3.1.5 Derive the relationship $(\sin^2 A + \cos^2 A) = 1$
- 3.1.6 Describe the periodic properties of the trigonometric functions.
- 3.1.7 State and use the sine rule for a labeled triangle in the form of $\frac{a}{\sin A} = \frac{b}{\sin B} = \frac{c}{\sin C}$

- 3.2 Formulae for cosine rule and area of a triangle.
- 3.2.1 State the cosine rule for a labeled triangle.
- 3.2.2 Recognise the conditions under which the cosine rule can be used.
- 3.2.3 Apply the cosine rule to the solution of practical problems.
- 3.2.4 Calculate the area of any triangle using the formulae

$$\frac{1}{2} ab \sin C \text{ and } \sqrt{s(s-d)(s-b)(s-c)}$$

- 3.2.5 Solve problems on triangles and quadrilaterals involving the use of the sine rule, cosine rule and formulae for areas of triangles.
- 3.3 Compound angle formulae for the addition of sine and cosine functions.
- 3.3.1 State the formulae
- (i) $\sin(A \pm B) = \sin A \cos B \pm \cos A \sin B$
- (ii) $\cos(A \pm B) = \cos A \cos B \mp \sin A \sin B$
- 3.3.2 Apply the relationships in 3.3.1 to obtain the result.
- $$2 \sin A \sin B = \cos(A - B) - \cos(A + B)$$
- 3.3.3 Solve numerical problems involving the relationships in 3.3.1 and 3.3.2.

TECHNICIAN MATHEMATICS

CLASS XII PAPER 3 hours - 100 marks

Candidates have to answer **Ten question out of Fourteen.**

1. THE SI SYSTEM OF UNITS AND CONVERSIONS

- 1.1 Basic SI Units
- 1.2 Supplementary and derived units .The need to know and use these units.
- 1.3 Multiples and sub divisions of the need to be able to convert & units manipulate the units
- 1.4 Representation of units symbols and quantities

2) MEASUREMENT CALCULATIONS

- 2.1 English & Metric measurements. The need to know and measure in English & Metric units.
- 2.2 Degree of accuracy and Metric dimension
- 2.3 Measuring Instruments – The rule Vernier, micrometer-Least Count.

- 3) MARKING OUT AND THE USE OF TRIGONOMETRY**
- 3.1 Sine, Cosine, Tangent ratios. The application of trigonometrical ratios to their uses and applications. Workshop. Calculations. The need to be able to mark/lay out holes on jobs, etc
 - 3.2 Pythagoras Theorem
 - 3.3 Sine and Cosine rules. Only applications.
 - 3.4 Division of the Circle-Chordal distance,
 - 3.5 Lines tangential to circles, To problems properties of Circles
- 4) CALCULATION INVOLVED IN TURNING AND BORING**
- 4.1 Cutting speed The need to know the relationship between
 - 4.2 Feed and tool travel speed and diameter of the job.
 - 4.3 Volume of metal removed
 - 4.4 Taper calculation and measurement Of tapers
- 5) SCREWS AND SCREW CUTTING**
- 5.1 Pitch and lead of a thread he need to know the basic aspect of
 - 5.2 Thread forms – ISO Metric, Square, threads and the ability to determine Acme, British Standard Whitworth, and set gear trains. British Association
 - 5.3 Helix Angle-Tool setting
 - 5.4 Graduated sleeves.
 - 5.5 Change gears calculations-metric and English.
- 6) AREAS, VOLUMES AND WEIGHTS.**
- 6.1 Areas of regular and irregular figures. The need to be able to determine the
 - 6.2. Volumes and weights of solids, weight & cost of objects & workshop, Prisms size, and solids in revolution and other components.
 - 6.2 Material weights and costs. Calculation of mass from drawing.
- 7) LIMITS AND TOLERANCES**
- 7.1 Classes of fits The need to calculate the amount of clearance and gauging dimensions
 - 7.2 Maximum and minimum clearance
 - 7.3 Gauging and gauges
- 8) SHAPING AND MILLING CALCULATIONS**
- 8.1 Machining time The need to be able to determine the time needed for an operation
 - 8.2 Rate of metal removal Cutting speed and feed
- 9) GEARS AND GEARING**
- 9.1 Calculation of spur gear data for The need to be able to determine– outside diameter gear details required for manufacture addendum, clearance, cutting depth ,and inspection of circular pitch, etc.
 - 9.2 Calculations involved in inspection of Gears.
- 10) BELT AND PULLEY SPEEDS**
- 10.1 Diameter and speed of pulley – The need to be able to determine Linear and rotational speeds. The speed and size of pulleys.

GEOMETRICAL & MECHANICAL DRAWING

(THIS SUBJECT MAY NOT BE TAKEN WITH
GEOMETRICAL AND BUILDING DRAWING)

Candidates will be required to reach a minimum standard in the subject as a whole. The use of drawing board, tea-squares and set-squares will be required. (Candidates may, if they wish, use a drawing board fitted with a parallel motion straight edge. The use of drafting machines will be permitted) A2 size paper will be used. The recommendations of IS:696 – 1972 Indian Standard, Code of Practice for General Engineering Drawing should be followed.

PLAIN AND SOLID GEOMETRY

CLASS - XI DETAILED SYLLABUS- 3 Hours - 100
marks

Section I : Plane Geometry

Construction and use of scales including diagonal scales. Enlargement and reduction of irregular plane figures. Construction of triangles quadrilaterals and polygons. Similar Plane figures. Problems on circles, tangents and normals, Loci such as the paths of points in simple link mechanism. Methods of construction of ellipse, including its elementary properties, parabola and rectangular hyperbola: cycloidal and involute curve.

Section II: Solid Geometry

Orthographic projection. (Diagrams printed in the question papers may be in either First or Third Angle projection; the projection used will be stated. Solutions in either First or Third Angle projection will be accepted). Projection involving use of auxiliary planes; simple problems on auxiliary projection, simple problems on the intersection of prisms, pyramids, cylinders, right circular cones and spheres.

Determination of true length of a line in space: sections and surface developments of prisms, pyramids, cylinders and right circular cones. Helix treated as a locus with applications on the projection of helices. Isometric and oblique projection without the use of Isometric scale.

SECTION III: AUTO CAD

The Pull-Down Menus, The Toolbars, Opening an Existing File, Saving a File as you Work, Making Changes, Opening Multiple Files, Closing AutoCAD, Getting to know the Draw Toolbar, Specifying Distances with Coordinates, Specifying Polar Coordinates, Specifying Relative Coordinates, Choosing Command options, Selecting Objects, Selecting Objects in AutoCAD, Selecting objects before the Command with Noun/Verb, Restrictions on Noun/Verb Object Selection, Editing with Grips, Stretching Lines Using Grips, Moving and Rotating with Grips, Getting Help, Display Data in a Text Window, Setting Up a Work Area, Specifying Units, Using the Auto CAD Modes as Drafting Tools, Using the Grid Mode as a Background Grid, Using the Snap Mode, Using Grid and Snap Together, Using the Coordinate Readout as Your Scale, Exploring the Drawing Process, Locating an Object in Reference to Others, Getting a Closer Look, Modifying an Object, Planning and Laying Out a Drawing, Making a Preliminary Sketch, Using the Layout, Putting on the Finishing Touches, Creating a Symbol, Inserting a Symbol, Using an Existing Drawing as a Symbol, Unblocking and Modifying a Block, Saving a Block as a Drawing File, Replacing Existing Files with Blocks, Other Uses for Blocks, Organising Information with Layers, Creating and Assigning Layers, Working on Layers, Controlling Layer Visibility, Finding the Layers You Want, Assigning Linetypes to Layers, Keeping Track of Blocks and Layers, Using the Log File Feature, Finding Files on Your Hard Disk, Inserting Symbols with Drag-and-Drop If You Want to Experiment, Creating a Template, Using a Template, Copying an Object Multiple Times, Making Polar Arrays, Making Rectangular Arrays, Developing Your Drawing, Importing Settings, Using the Quick Setup Wizard, Using and Editing Lines, Finding Distances Along Arcs, Changing the Length of Objects, Extending an Object to Meet Another Object, Stretching Objects, Drawing Parallel Lines, Customizing Multilines, Eliminating Blocks, Layers, Linetypes, Shapes, and Styles, Understanding Regeneration and Redraw, Exploring Other Ways of Controlling AutoCAD's Display, Freezing Layers to Control Regeneration Time, Block Visibility with Freeze and Thaw, Taking Control of Regens, Using the AutoTracking Feature, Understanding Text Formatting in AutoCAD, Adjusting the Text height and Font, Adding Color, Stacked Fractions, and Special Symbols,

SECTION III: AUTO CAD

Adjusting the Width of the Text Boundary Window, Adjusting the Text Alignment, Editing Existing Text, Finding and Replacing Text, Understanding Text and Scale, Organizing Text by Styles, Creating a Style, Using a Type Style, Setting the Current Default Style, Understanding the Text Style Dialog Box Options, Renaming a Text Style, Creating a Dimension Style, Setting the Dimension Unit Style, Setting the Height for Dimension Text, Setting the Location of Dimension Text, Choosing an Arrow Style, Setting the Dimension Scale, Setting the Center Mark Size, Drawing Linear Dimensions, Finding the Dimension Toolbar, Placing Horizontal and Vertical Dimensions, Continuing a Dimension, Editing Dimensions, Appending Data to Dimension Text, Locating the Definition Points, Making Minor Adjustments to Dimensions Using Grips, Changing Style Settings of Individual Dimensions, Editing Dimensions and Other Objects Together, Dimensioning Nonorthogonal Objects, Dimensioning Nonorthogonal Linear Distances, Dimensioning Angles, adding a Note with an Arrow, The Leader Options, Skewing Dimension Lines, Applying Ordinate Dimensions, Adding Tolerance Notation, Introducing Polylines, Drawing a Polyline, Polyline Options, Editing Polylines, Smoothing Polylines editing Vertices, Creating a Polyline Spline Curves, Using True Spline Curves, Drawing a Spline, Fine-Tuning Spline Curves, Marking Divisions on a Curve, Dividing Objects into Segments of Equal Length, Dividing Objects into Specified Lengths, Sketching with AutoCAD, Freehand Sketching with AutoCAD, Adding Hatch Patterns, Drawing Filled Circles, Toggling Solid Fills On and Off.

GEOMETRICAL & MECHANICAL DRAWING

CLASS XII DETAILED SYLLABUS 3 Hours- 100marks

Candidates will be required to answer ALL questions

The preparation of working drawings and assemblies from dimensioned sketches based on the following:

- (1) Fastenings (nuts, bolts, studs, keys, cotters, pins, locking devices);
- (2) Rigid and flexible joints;
- (3) Screw threads; their projection and the proportions of standard types; profiles and proportions of spur gear teeth; conventional methods of drawing gear wheels;
- (4) Transmission of motion and power, bearings, supports, shafts, coupling and clutches;
- (5) Pressure transmission in pipes using water, oil steam and gas, joints, unions, tees and bends, expansion joints, pressure packing;
- (6) Constructional details of prime moves and simple machine tools;
- (7) The use of reference points and planes in dimensioning, machining and surface texture symbols;
- (8) Toleranced dimensions involving the use of IS: 919 or B.S. 4500 Limits and Fits for Engineering.

Candidates will be expected to follow the recommendations given in IS: 696 – 1972 Indian Standard, Code of Practice for General Engineering Drawings. They should be familiar with both First and Third Angle projections.

ENGINEERING SCIENCE

DETAILED SYLLABUS

CLASS XI THEORY – 3 HOURS 100 MARKS

Examiners will attach importance to an understanding of scientific principles and will look for evidence that these have been studied practically. The examiners may ask to see the practical note-books.

There will be **ONE** Paper consisting of **two** sections with equal weightage

Section A – Physics and Section B – Chemistry

SECTION A – PHYSICS

1. Velocity and acceleration Law of motion. Force, mass and acceleration. Acceleration due to gravity. Measurement of g . including examples of bodies moving with variable acceleration, treated graphically.
2. Angular velocity and angular acceleration.
3. Composition and resolution of velocity. Simple problems on projectiles involving combined horizontal and vertical motion.
4. Measurement and effects of force. Equilibrium of concurrent forces in plane. Parallelogram, triangle and polygon of forces. Reaction, resultant and equilibrant. Bow's notation. Equilibrium of body on inclined plane. Treatment by graphical and mathematical methods.
5. Moments. Application to parallel forces, levers, vertically loaded rigid beams. Centre of gravity: experimental determination and calculation in simple cases. Its relation to stability.
6. Pressure in liquids and its transmission. Principle of Archimedes; flotation.
7. Density and specific gravity of solids and liquids. Simple hydraulic pumps and jacks. Lift and force pumps; the siphon.
8. Air pressure. Boyle's law. Barometers. Manometers and the Bourdon gauge. The bicycle pump. Details of the Fortin barometer are not required.
9. Temperature and temperature scales.
10. Thermal expansion of solids, liquids and gases. Coefficient of linear expansion of solids and coefficient of cubical expansion of liquids and gases. Charles's law. Absolute temperature. (Questions will not be set on apparent coefficients of expansion).
11. Conduction, convection and radiation.
12. Conversion of heat to mechanical energy and vice versa. Mechanical equivalent of heat, including any one method of determination.
13. Friction. Conditions affecting friction. Lubrication. Conditions should include types of materials, their surface finish, and wetness and dryness.

14. Momentum. Conservation of momentum, including rate of change of momentum and relationship with mass and acceleration. Knowledge of coefficient of restitution is not required.

SECTION B - CHEMISTRY Elementary Chemistry

States of aggregation of matter, Indestructibility of matter and of energy, Elements and Compounds, The balance, weight and measures, Effect of pressure and temperature on volume of gases.

Coefficient of cubical expansion of liquid and gases, Charles's Law, Absolute Temperature Common laboratory processes, Mixture, Decantation, Combination by weight and volume Decomposition, dissociation, Combustion, Oxidation, Reduction, Acids, bases and salts, Neutralisation

Inorganic Chemistry

Hydrogen, Oxygen, Nitrogen, Ozone, Air, water, Ammonia Sulphuric Acid, Hydrochloric acid, Nitric Acid, Coal, Coal gas, Sodium, Potassium, Calcium, Magnesium, Carbon, Phosphorus, Zinc, Copper, Lead, Aluminum, Tin, Nickel, Iron, Silver, Oxides, Hydroxides, Chlorides, Nitrates, Sulphates, Carbonates, Hydrogen peroxide, Carbon monoxide, Carbon dioxide, Sulphur dioxide, Hydrogen sulphide, Chlorine, Bleaching powder Chlorates of Calcium and potassium Catalytic agents, Acetylene

ENGINEERING SCIENCE

CLASS XII Paper 1 - 3 Hours - 100 marks

There will be only one paper.

Note: All questions will be set in the S.I system. The unit abbreviation to be used in all question papers in this subject will be those contained in the guide to the use of International system (SI) units SP; 5 – 1969 (Published by the Indian Standards Institution). A list of common abbreviations is printed at the end of the syllabus.

1. Strength of materials Simple problems. Hooke's law, stress and strain. Young's modulus. Tension and compression. Elastic limit Ultimate strength. Factors of safety. Tensile test results, Shear Stress. Load – extension graphs.
2. Statics - Forces
 - * Equilibrium of three inclined forces: Concurrency
 - * Pin – jointed frame works
 - Magnitude and nature of forces in the members of the frame work. (graphical solutions)
3. Limiting friction. Coefficient of friction.
4. Work. Work done by constant and by varying force; graphical representation of, and calculations thereon. Energy, potential and kinetic. Conservation of energy and conversion into work, work done in rotation. Torque.
5. Machine. Simple single-string pulley system. Simple and differential wheel and axle, Weston pulley block. Screw jack. Worm (single start thread and wheel). Gear and belt drives. Velocity ratio, mechanical advantages and efficiency.
6. Power and Energy
 - Power transmitted by a belt drive.
 - Work done and power consumed in machining.
 - Energy conversion
 - Mechanical efficiency.
7. Quantity of heat. Joule, Celsius heat unit. Specific heat capacity of solids and liquids, their

determination. Change of state. Latent heat; their determination. Melting and boiling points; the effect of pressure. Heat as a form of energy. Calorific value of fuels (excluding experimental determination).

8. Magnetism. Magnetic properties of iron and steel. The magnetic circuit; qualitative treatment only with examples from transformers and machines. The compass needle. Magnetic effect of current in straight wire, single turn coil and solenoid, treated qualitatively. Electromagnets and their simple application. Relation of direction of current in conductor and lines of magnetic force applied examples of the application of electromagnets to include electric trembler and relay.
9. The simple circuit. Conductors and insulators, Electromotive force, potential difference, current, quantity and resistance; the volt, the ampere, coulomb ampere-hour and Ohm's law. Measurement of resistance, including wheatstone bridge, Receptivity. Resistors in series and in parallel.
10. Heating effect of current. Energy and power. Conversion of electrical to mechanical energy and vice versa. The joule, Watt, and Kilowatt-hour. Simple applications of heating effect. Effect of temperature on resistance. Temperature coefficient. Examples to include various domestic heating appliances and filament lamps.
11. Moments. Equilibrium of a system of coplanar forces. Centroid and centre of gravity (mass).

List of abbreviations for the names of units.

Metre	m	Kilogram-force	kgf
Square, cubic	m ²	newton	N
Metre	m ³	atmosphere	atm
Cubic centimeter	cm ³	(pressure)	
Litre	l	convention millimetre	
		of mercury	mmHg
milliliter	ml	joule	J
second(time)	s	watt	W
minute(time)	min	watt hour	Wh
hour	h	degrees(temperature)	°C, °K
day	d	degrees(interval)	degC, deg K
cycle per second	c/s		deg F
revolution per minute	rev/min	ampere	A, amp
gram	g	volt	V
gram-force	gf	ohm	Ω
kilogram	kg		

Prefixes

X10 ⁻⁶	mega	M	X10 ⁻²	centi	c
X10 ⁻³	kilo	k	X10 ⁻³	milli	m
X10 ⁻¹	deci	d	X10 ⁻⁶	micro	μ

List of Tools & Equipments for “Mechanical Engineering Technician” for 25 Trainees

Sl .No.	Particulars	Qty.
1.	Steel rule 300 cm graduated both in English & Metric Units	25 nos.
2.	Outside spring caliper 150 mm.	25 nos.
3.	Inside spring caliper 150 mm.	25 nos
4.	Hermaphrodite caliper 150 mm.	25 nos
5.	Divider spring 150 mm.	25 nos
6.	Centre punch 100 mm.	25 nos
7.	Hammer B.P.0.5 kg	25 nos
8.	Try square 300 mm.	25 nos
9.	Scriber 150 mm x 3 mm.	25 nos
10.	Combination pliers 150 mm.	25 nos
11.	Safety glasses.	25 nos
12.	File flat bastard 300 mm.	25 nos
13.	File flat 2 nd cut 250 mm.	25 nos
14.	Engineers screw driver 300 mm.	25 nos
15.	File flat smooth 200 mm.	25 nos
16.	Cold chisel flat 25 x 200 mm.	25 nos
Tools. Instruments & General Shop Cut Fits:		
17.	Surface plate 400 mm x 400 mm grade.	1 no.
18.	Table for surface plate 900 x 900 x 1200 mm.	1 no.
19.	Marking off table 1200 x 1200 x 900 mm.	1 no.
20.	Scribbling block universal 300 mm.	2 nos.
21.	Vee block 100/7-80-A.	2 nos.
22.	Try square 300 mm.	2 nos.
23.	Outside spring caliper 200 mm.	2 nos.
24.	Divider spring 200 mm.	2 nos.
25.	Inside spring caliper 200 mm.	2 nos.
26.	Straight edge steel 1 metre	1 no.
27.	Straight edge steel 500 mm.	1 no.
28.	Steel tape 2 metre in case	1 no.
29.	Steed rude 60 cm graduated both in English and Metric units.	2 nos.
30.	Sprit level 2 v 250, 05/metre.	1 no.
31.	Hammer B.P. 800 grams with handle.	12 nos.
32.	Screw driver heavy duty 300 mm w/handle	4 nos.
33.	Hammer lead 1 kg	6 nos.
34.	Combination set 300 mm.	4 nos.
35.	Spindle blade screw driver 10 mm.	4 nos.
36.	Allen hexagonal keys 2.5 – 12	2 set
37.	Spanner D.E.G.P. series 2 (sets of 7 pieces)	6 sets
38.	Adjustable spanner 300 mm.	2 nos.
39.	Reduction sleeve morse Taper 2-1, 3-1, 4-1, 4-2, 5-1, 5-2, 6-1	2 set
40.	Angle plate size 4	2 nos.

41.	Angle plate adjustable 250 x 150 x 175	2 nos.
42.	Solid parallels in pairs (Different sizes) in Metric	25 prs.
43.	Oil can pressure feed 500 mm.	25 nos.
44.	Oil stone 150 x 50 x 25 mm.	2 nos.
45.	Oil stone 100 x 12 mm square	2 nos.
46.	Number drills H.S.S. (Parallel shank)	1 set
47.	Letter drills H.S.S. (Parallel shank)	1 set
48.	Drill (parallel shank)	2 sets.
49.	Twist drills 3 mm to 13 mm (parallel shank)	2 sets.
50.	Drill chuck 0.20 with taper shank	1 no.
51.	Centre drill 1 to 5.	2 sets.
52.	Grinding Wheel dresser (Diamond)	1 no.
53.	Clamps 'C' 100 mm.	2 nos.
54.	Clamps 'C' 150 mm.	2 nos.
55.	Clamps 'C' 200 mm.	2 nos.
56.	Clamps tool makers 50 mm and 100 mm	1 each
57.	Tap and die set in box metric pitch	1 set
58.	Drill H.S.S. taper shank	2 set
59.	File flat 2 nd cut 250 mm	4 nos.
60.	File flat smooth 150 mm	4 nos.
61.	File H/R 2 nd cut 250 mm	4 nos.
62.	File flat smooth 150 mm	4 nos.
63.	File triangular smooth 200 mm	4 nos.
64.	File round 2 nd cut 250 mm	4 nos.
65.	File square 2 nd cut 250 mm	4 nos.
66.	Reamer 6 mm to 25 mm by 1 mm.	1 set
67.	Reamer adjustable 10 mm to 15 mm by 75 mm	1 set
68.	Tools bit H.S.S. 6 mm square	1 doz.
69.	Tools bit H.S.S. 10 mm square	1 doz.
70.	Tools bit holder (Armstrong) L.H.	4 nos.
71.	Tools bit holder (Armstrong) R.H.	4 nos.
72.	Assorted tools for lathe, shaper, slotter and planner of different shapes and sizes As required.	
73.	Hacksaw frame adjustable 250 – 300 mm w/blades.	2 nos.
74.	Table chuck 75 mm Jaw swivel base	1 no.
75.	Machine vice 200 mm swivel base	3 nos.
76.	Machine vice 160 mm swivel base	3 nos.
77.	Hand vice 50 mm Jaw	4 nos.
78.	Radius truing attachment	1 no.
79.	Angle truing attachment	1 no.
80.	Compound angle vice(standard size)	1 no.
81.	Universal vice	1 no.
82.	Universal table angle plate.	1 no.
83.	Taper shank twist drill set 6-30 mm x 1.5 mm to suit Radial drilling machine	1 set
84.	Shaper tool holder turret type	2 nos.
85.	Base chuck for slotter	1 no.
86.	Shaper indexing centre	1 no.
87.	Knurling tools (set of 3) straight & diamond set each	1set
88.	Angle plate with slots 300 x 300 & 400 x 400 mm	for each 1 no.
89.	Pliers cutting 200 mm.	2 nos.
90.	Wing compass 600 mm.	1 no.
91.	Magnifying glass 75 mm.	2 nos.
92.	Punch letter set 3 mm.	1 no.
93.	Punch number set 3 mm.	1 no.
94.	Carbide tipped tools of different sizes & shapes (Throw away tips)	2 sets.
95.	Hand hammer 1 kg with handle	2 nos.
96.	Tongs round	2 nos.
97.	Hot set rodged	2 nos.

98.	Tong flat	2 nos.
99.	Cold set rodded	2nos.
100.	Poker	2 nos.
101.	Quenching tank	1 no.
102.	Hard die	2 nos.
103.	Leather apron	2 nos.
104.	Shovel	2 nos.
105.	Rake	2 nos.
106.	Trammel Learning	2 nos.
107.	Smith's square 45 x 30 cm.	1 no.
108.	Fuller top & bottom 6 mm x 10 mm(pair)	1 each
109.	Swage block 35 x 35 x 12.5 cms.	1 no.
110.	Swage top & bottom 13 mm, 19 mm & 25 mm.	1 pair

Milling Cutters:

1.	Cylindrical cutter 63 x 90 bore dia.	2 nos.
2.	Cylindrical cutter 80 x 90 bore dia.	2 nos.
3.	Side and face cutter B 80 x 8.	2 nos.
4.	Side and face cutter B 160 x 10	2 nos.
5.	Side and face cutter B 80 x 10	2 nos.
6.	Side and face cutter B 100 x 12	2 nos.
7.	Side and face cutter B 160 x 16	2 nos.
8.	Side and face cutter A 100 x 20	2 nos.
9.	Side and face cutter A 100 x 10	2 nos.
10.	Equal angle cutter 45/100	2 nos.
11.	Equal angle cutter 60/100	2 nos.
12.	Equal angle cutter 90/100	2 nos.
13.	Double angle unequal cutter 50 x 12 x 550	2 nos.
14.	Double angle unequal cutter 63 x 18 x 60°	2 nos.
15.	Double angle unequal cutter 80 x 32 x 700	2 nos.
16.	Double angle unequal cutter 100 x 36 x 750	2 nos.
17.	Single angle cutter 63 x 18 x 450 RH	2 nos.
18.	Single angle cutter 63 x 18 x 450 LH	2 nos.
19.	Single angle cutter 63 x 18 x 600 RH	2 nos.
20.	Single angle cutter 63 x 18 x 600 LH	2 nos.
21.	Single angle cutter 63 x 28 x 700 RH	2 nos.
22.	Single angle cutter 63 x 28 x 700 LH	2 nos.
23.	Single angle cutter 63 x 28 x 800 LH	2 nos.
24.	Slot milling cutter 6 x 63 bore	2 nos.
25.	Slot milling cutter 10 x 100 bore	2 nos.
26.	Slitting saw 80 x 3 x 48 A	2 nos.
27.	Slitting saw 125 x 3 x 128 A	2 nos.
28.	Slitting saw 100 x 4 x 100 A	2 nos.
29.	Slitting saw 100 x 5 x 32 B	2 nos.
30.	Slitting saw 200 x 6 x 64 B	2 nos.
31.	Slot drill (key seating) 3 mm.	2 nos.
32.	Slot drill (key seating) 4 mm.	2 nos.
33.	Slot drill (key seating) 6 mm.	2 nos.
34.	Slot drill (key seating) 8 mm	2 nos.
35.	Slot drill (key seating) 12 mm.	2 nos.
36.	T-Slot cutters to suit T-headed bolts of 10, 12 mm straight-shank	2 each
37.	T-Slot cutter to suit 'T' headed bolts of 14, 18, 22 taper shank	2 each
38.	Drill fluting cutters nos.8 to 16.	1 set
39.	Reamer fluting cutters nos 1 to 9.	1 set
40.	Reamer fluting cutters nos. 1 to 8.	1 set
41.	Milling cutter (involute gear tooth) 8, 10, 12, 16 & 20 D.P. No 1 to 8	1 set
42.	Milling cutters (involute gear tooth) 1,2,2 1/2,3 & 4 module	1 set
43.	Convex milling cutter 2.5 mm.	2 nos.
44.	Convex mulling cutter 4 mm	2 nos.
45.	Convex milling cutter 10 mm.	2 nos.
46.	Convex milling cutter 20 mm.	2 nos.
47.	Concave milling cutter 2.5 mm.	2 nos.
48.	Concave milling cutter 4 mm.	2 nos.

49.	Concave milling cutter 10 mm.	2 nos.
50.	Concave milling cutter 20 mm.	2 nos.

51.	Milling cutter corner rounding 2.5 mm.	2 nos.
52.	Milling cutter corner rounding 4 mm.	2 nos.
53.	Milling cutter corner rounding 10 mm.	2 nos.
54.	Milling cutter corner rounding 16 mm.	2 nos.
55.	Milling cutter face mill inserted type 150 x 50 bore	2 nos.
56.	Milling cutter face mill inserted type 150 x 50 bore	2 nos.
57.	Sheel end mill 63 mm x 40 bore.	2 nos.
58.	Sheel end mill 63 x 40 bore.	2 nos.
59.	Wood ruff key seating cutter A 13.5 x 3, A 16.5 x 4, A 19.5 x 5 and A 19.5 x 60	2 each
60.	End mill cutter (parallel shank) 3, 6, 10, 16, 18, 22 mm	2 each
61.	Dovetail cutter 600 and 550	2 each
62.	Bevel gear cutter, cutter, 14 D P or equivalent module	1 set
63.	Counter boring & counter sinking cutter (standard size)	2 each

Measuring Instruments:

1.	Micrometer out side 0-25 mm	4 nos.
2.	Micrometer out side 25-50	2 nos.
3.	Micrometer out side 50-75	1no.
4.	Micrometer inside 25 mm to 150 mm with extn. Rod.	2 nos.
5.	Micrometer depth gauge 0-200 mm.	2 nos.
6.	Direct reading vernier caliper B 300 (Direct reading with dial)	1 no.
7.	Vernier height gauge 250 mm.	1 no.
8.	Vernier gear tooth caliper.	1 no.
9.	Vernier bevel protractor with 150 mm blade	1 no.
10.	Bevel gauge 200 mm	1 no.
11.	Telescope gauge 13 mm to 300 mm.	1 no.
12.	Sine bar 200 mm.	1 no.
13.	Compound dial gauge with stand (Metric)	1 no.
14.	Dial test indicator with magnetic gauge type 1 grade A with magnetic base.	1 no.
15.	Centre gauge.	1 no.
16.	Slip gauge set (Normal set) metric (For the whole instt)	1 set
17.	Screw pitch gauge for metric pitches (.25-6 mm)	2 sets
18.	Radius gauge metric set (1-6 mm)	1 set
19.	Limit plug gauge 5 mm to 25 mm by 2.5 mm.	1 set
20.	Ring gauges 5 mm to 25 mm by 2.5 (Go & No Go)	1 set
21.	Taper gauge M.T.No 1, 2, 3, 4 & 5	1 set
22.	Feeler gauge	1 no.
23.	Planer gauge standard size.	1 no.
24.	Steel lockers for 25 trainees	1 no.
25.	Steel chair for instructor	1 no.
26.	Steel table for instructor	1 no.
27.	Work bench for Fitters with two vices of 100 mm jaw.	1 no.
28.	Steel cupboard 180 x 90 x 45 mm.	1 no.
29.	Steel cupboard 120 x 60 x 45 cm	1 no.
30.	Black board with easel	1 no.
31.	First aid box	1 no.

General Installation:

1.	Shaping machine 450 mm storke (Motorised) with all attachments.	1 no.
2.	Shaping machine 315 mm storke (Hydraulic) with all attachments	1 no.
3.	Double column planer 1500 x 1000 x 1000 (Motorised) with all attachments	1 no.
4.	Stotter 180 mm stroke (Motorised) with all attachments.	2 nos.
5.	Lather general purpose all geared-height of centres 150 mm to below between centre 150 mm supplied with 3 jaw & 4 jaw chuck face plate turner turning attachments steadies, etc and set of lathe tools	2 nos.
6.	Tool and cutter grinder 250 mm to admit 450 mm between centre fully motorized work head supplied with tool rest of different types table clamps & other attachments.	1 no.
7.	Drilling machine pillar 20 mm capacity	1 no.
8.	Radial drill 1200 mm are motorized with tapping attachment.	1 no.
9.	Silicon carbide grinder for carbide tipped tools.	1 no.
10.	Milling machine universal horizontal (Motorised) with all attachment such as: a. Universal head b. Vertical head c. Slotting attachment d. Rack cutting attachment e. Rotary table f. Diving head g. Adaptors, arbors & collects etc. for shank and mill From 3 mm to 30 mm.	no.1 1 no.
11.	Milling machine universal horizontal no. 0 with all attachments	1 no.
12.	Milling machine plain type horizontal (Motorised) No.2 with all attachments	1 no.
13.	Milling machine vertical No. 1 (Motorised) with all attachments.	1 no.
14.	Surface grinding machine wheel dia. 180mm (or near) reciprocating table Longitudinal table traverse 200 mm (or near) fitted with adjustable traverse stop. Full motorized supplied with magnetic chuck 250 mm x 120 mm diamond tool holder set of spanner grease gun etc.	1 no.
15.	Forge portable hand blower 375 mm to 450 mm dia.	1 no.
16.	Anvil 50 kg with stand.	1 no.
17.	CNC TURNING CENTRE WITH ALL ACCESSORIES	1 no.
18.	CNC MACHINING/CENTRE WITH ALL ATTACHMENTS	1 no.