ENGINEERING SCIENCE (867)

This subject may not be taken with Physics.

The syllabus is designed for candidates who have followed a course with a bias towards engineering.

The 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 notebooks.

CLASS XI

There will be two papers in the subject:

Paper I - *Theory: 3 hours…… 80 Marks*

Paper II - *Project Work ……. 20 Marks*

PAPER I (THEORY): 80 MARKS

Note: All questions will be set in the S.I. System. The unit abbreviations 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).

1. Velocity and acceleration. Laws 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 problem 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; floatation. Density and specific gravity of solids and liquids. Simple hydraulic pumps and jacks. Lift and force pumps; the siphon.
7. Air Pressure. Boyle's law. Barometers. Manometers and the Bourdon gauge. The bicycle pump. (Details of the Fortin barometer are not required.)
8. Temperature and temperature scales.
9. Thermal expansion of solids, liquids and gases. Coefficient of linear expansion of solids and coefficient of cubical expansion of liquids and gases. Charles' law. Absolute temperature. (Questions will not be set on apparent coefficients of expansion).
10. Quantity of heat. Joule, Centigrade heat unit. Specific heat capacity of solids and liquids; their determination. Change of state. Latent heats: their determination. Melting and boiling points; the effect of pressure. Heat as a form of energy. Calorific value of fuels (excluding experimental determination).
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.

PAPER II (PROJECT WORK): 20 Marks

In addition to the syllabus prescribed above, candidates are also required to be assessed in Project Work. All candidates will be required to have completed two projects from any topic/s covered in theory.

The Project work will be assessed by the subject teacher.

Mark allocation for *each* project (10 marks) :

Criteria		Marks
1.	Title of the Project and Introduction	1
2.	Content	3
3.	Presentation and originality	2
4.	Conclusion/Comments/Summary	1
5.	Viva-Voce	3
TOTAL		**10**

List of suggested assignments for Project Work:

1. Study changes in the velocity of a body under the action of a constant force and determine its acceleration. Also plot a graph between velocity and time under a constant force. Discuss the variation in acceleration for masses m, 2m, 3m, 4m and 5m placed on a smooth surface when constant force **F** is applied on them.

   Similarly discuss the variation in acceleration when different forces F, 2F, 3F, 4F and 5F are applied on a body of mass **m**.

2. You are given a rubber pipe, a nozzle, source of water under pressure, i.e., a tap connected to an overhead water tank, a measuring tape and a large size protractor.

   (i) Study the variation in the range of the jet of water with change in the angle of projection.

   (ii) How would the range change if the velocity of projection is changed (increased/ decreased)?

   (iii) Calculate velocity of projection by using maximum value of horizontal range measured as above.

   (iv) How can you achieve a constant pressure of inlet water to keep the projection velocity of water constant?

   (v) Study the variation in maximum height attained by the water stream for different angles of projection.

3. Study atmospheric pressure and humidity (as given in the newspaper) for a month. Plot a graph between atmospheric pressure and humidity. Is there any relationship between humidity and atmospheric pressure? Discuss.

4. Conduct an extensive study on any Indian /foreign Physicist. Prepare a report discussing their contributions.

CLASS XII

There will be two papers in the subject:

Paper I - *Theory: 3 hours…… 80 Marks*

Paper II - *Project Work ……. 20 Marks*

PAPER I (THEORY): 80 MARKS

Note*: All questions will be set in the S.I. System. The unit abbreviations 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).*

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.
2. Friction. Conditions affecting friction. Lubrication. Conditions should include types of materials, their surface finish and wetness or dryness.
3. Limiting friction. Coefficients 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. Machines. Simple single-string pulley systems. Simple and differential wheel and axle. Weston pulley block. Screw jack. Worm (single start thread and wheel). Gear and belt drives. Velocity ratio, mechanical advantage and efficiency.
6. Power. Simple treatment of steam and internal combustion engines. Indicators diagrams. Indicated mean effective pressure. Indicated and brake horsepower. Methods of measurement of power. Rope brake and Prony brake. Hydraulic power (as given by the product of constant pressure and rate of volume change). Mechanical efficiency. Relationship between rev/min and working strokes per minute in double-acting steam engines and in two and four-stroke internal combustion engines. The oscillating cylinder steam engine is not required.
7. Momentum. Conservation of momentum, including rate of change of momentum and relationship with mass and acceleration. Knowledge of coefficient of restitution is not required.
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 applications. Relation of direction of current in conductor and lines of magnetic force applied. Examples of the application of electromagnets to include electric trembler bell and relay.
9. The simple circuit. Conductors and insulators. Electromotive force, potential difference, current, quantity and resistance; the volt, ampere, coulomb ampere-hour and ohm. Ohm's law. Measurement of resistance, including Wheatstone bridge, Resistivity. 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. Chemical effect of current field. Electrolytes. Electrolysis. Electrochemical equivalent. Production of current by chemical action. Simple voltaic cell. Primary and secondary cells. Polarisation: prevention and removal. Cells in series and in parallel. Chemical equations are not required.
12. Current-carrying conductor in magnetic field. The D.C. motor including series and shunt windings. Galvanometers, voltmeters and ammeters. Shunts and multipliers. A qualitative treatment of multiple D.C. motors is included.
13. Electromagnetic induction: the laws of induction. Back e.m.f. of motor. Starting resistance for D.C. motor. Simple a.c. and D.C. generators. Relation of direction of lines of force, motion of conductor and current in coil. Eddy currents. Transformers. The induction coil; the coil ignition system. A qualitative treatment of multipole D.C. generators is included.

PAPER II (PROJECT WORK): 20 Marks

In addition to the syllabus prescribed above, candidates are also required to be assessed in Project Work.

PROJECT WORK FOR CLASS XII

The Project work will be assessed by the subject teacher and the Visiting Examiner appointed locally and approved by CISCE.

All candidates will be required to have completed **two** projects from any topic/s covered in theory.

Mark allocation for *each* project (10 marks) *:

Criteria		Marks
1.	Title of the Project and Introduction	1
2.	Content	3
3.	Presentation and originality	2
4.	Conclusion/Comments/Summary	1
5.	Viva-Voce (Visiting Examiner)	3
TOTAL		**10**

List of suggested assignments for Project Work:

1. Show mathematically that the energy of a simple pendulum is conserved. Also draw and interpret the following for the same:
   - displacement-time graph
   - kinetic energy-displacement graph
   - potential energy-displacement graph
   - total (mechanical) energy and displacement graph.
2. Study and represent graphically the work done on a body of mass *m* under the action of a constant force and by a varying force. Show calculations and discuss.
3. Study the fundamental forces in nature governing the diverse phenomena of the macroscopic and microscopic world. Discuss the progress related to the unification of these forces.
4. You have studied about the strength of materials. In this context, discuss the following:
   - Stress and strain, their types, Hooke's law, Young's modulus, elastic limit, permanent set and ultimate strength.
   - Take a stress-strain curve for a metal and mark the relevant points on the graph.
   - Is it correct that a material that stretches more is more elastic? Discuss with examples.
5. Observe any five surfaces at home:
   - Which surface produces more friction and which produces less friction (on the basis of type of material, surface finish, dryness/wetness). Discuss giving reasons.
   - Frictional force opposes relative motion (impending or actual) between two surfaces in contact. Discuss. Also, show graphically the relation between force applied F and force of static friction f_s, / force of kinetic friction f_k for any pair of surfaces in contact.
   - A block of wood is given a push which slides along a horizontal, flat table surface, coming to a stop. Discuss what happens to the momentum of the block?
   - A ball rolls without slipping on a perfectly flat plane of infinite extent. Will it roll forever? Discuss.
   - Discuss advantages and disadvantages of friction in daily life.
6. Observe ten articles at home (five simple machines and five articles in which a combination of machines is being used) such as plier, scissors, knife, cycle/motorcycle, ramp, steering wheel, roller of the cord for blinds, juicer/mixer/blender, etc. For each of the articles selected:
   - Identify the type of machine/s used.
   - Draw simple diagrams for each item selected and mark the load, effort and fulcrum. Write expressions for mechanical advantage, velocity ratio and efficiency.
   - Discuss briefly the utility of each type of machine used.
7. Study electricity bills of your home issued by the electricity department from January to December. Prepare a month wise analysis of units of electricity consumed and bill paid in a tabular form. Represent the same graphically. Suggest some ways in which you can economise electricity consumption at home.
8. Observe a transformer installed in your locality and draw its labelled diagram. Discuss the principle on which it works and the reasons for energy losses. Find out the transmission and distribution mode of electrical energy from a power plant to a consumer. Discuss its pros and cons.
9. Assemble a household circuit comprising three bulbs, three on/off switches, a fuse, and a power source from the given materials (Three bulbs (6V,1W) each, main switch of a power supply (battery eliminator), three switches, fuse (0.6A), connecting wires with red and black plastic coating, fuse wire, a plier and a cutter).

   Draw a circuit diagram of the actual layout and write the theory and procedure involved.

NOTE: No question paper for Project work will be set by CISCE.

SAMPLE TABLE FOR PROJECT WORK

S. No.	Unique Identification Number (Unique ID) of the candidate	PROJECT 1					PROJECT 2					TOTAL MARKS
		A	B	C	D	E	F	G	H	I	J	
		Teacher	Visiting Examiner	Average Marks (A + B ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (C + D)	Teacher	Visiting Examiner	Average Marks (F + G ÷ 2)	Viva-Voce by Visiting Examiner	Total Marks (H + I)	(E + J)
		7 Marks	7 Marks	7 Marks	3 Marks	10 Marks	7 Marks	7 Marks	7 Marks	3 Marks	10 Marks	20 Marks
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												

*****For breakup of the 7 Marks to be awarded separately by the Teacher and the Visiting Examiner, please refer to the table giving the criteria for mark allocation for *each* project.

NOTE: VIVA-VOCE (3 Marks) for each Project is to be conducted only by the Visiting Examiner and should be based on the Project only.