UNIVERSITY OF RUHUNA

Faculty of Engineering

End-Semester 3 Examination in Engineering: March 2026

Module Number: EE3205 **Module Name: Power and Energy**

[Three Hours]

[Answer **all questions**, each question carries 10 marks]

Q1 a) i) State the three most widely used primary energy sources in the world in recent years.

ii) The annual petroleum energy consumption and electricity consumption of an economy are 4,964 ktoe and 1,356 ktoe respectively. If the Gross Domestic Product is 27,419,804 LKR million, calculate the energy intensity of the economy.

iii) With the aid of a suitable diagram, briefly explain what is meant by "elastic demand".

iv) The energy sector is a combination of four inter-related stages. Briefly explain the "energy supply" stage.

[5.0 Marks]

b) i) State three hydropower complexes that are owned by Electricity Generation Lanka (Pvt.) Limited (Ceylon Electricity Board).

ii) Define the terms Independent Power Producer (IPP) and Emergency Power Producer (EPP) in the Sri Lankan electricity sector.

iii) Briefly explain why countries are transitioning from fossil fuels to renewable energy sources to meet their energy demand.

iv) Briefly explain two measures towards a sustainable energy sector.

[5.0 Marks]

Q2 a) Daily load cycle of a generating station with a capacity of 100 MW is given in the Table Q1.

i) Plot the daily load curve.

ii) Calculate the average load and load factor.

iii) Calculate the reserve capacity of the plant.

iv) Calculate the plant capacity factor.

[5.0 Marks]

b) i) State any two lighting control systems used as energy saving measures and briefly explain one of them.

ii) State two benefits of power factor correction.

[1.0 Marks]

c) A single phase motor connected to 230 V, 50 Hz supply takes 32.5 A at a power factor of 0.75 lagging.

i) Calculate the capacitance required in parallel with the motor to raise the power factor to 0.95 lagging.

ii) If there is a power loss of 400 W in the above capacitor bank, what would be the new power factor of the system?.

[4.0 Marks]

Q3 a) With the aid of suitable diagrams and/or examples describe any three of following Demand Side Management (DSM) techniques.

i) Peak-shaving

ii) Valley filling

iii) Demand-shifting

iv) Strategic conservation

v) Strategic load growth

[4.5 Marks]

b) i) Briefly explain following DSM measures in Sri Lankan context.

I. Time of Use (ToU) pricing
II. Real time pricing
III. Pumped storage power plants

ii) Briefly describe how DSM is incorporated as a national policy objective.

[5.5 Marks]

Q4 a) i) Draw schematic diagram of a gas power plant and briefly describe function of following components.

I. Compressor

II. Regenerator

III. Starting motor

ii) What is the basis of determining diameter and wall thickness of a "penstock" in a hydro power plant?

iii) Briefly describe two environmental impacts of a large hydro power plant.

iv) State two disadvantages of a diesel power plant.

v) State three starting systems used in a diesel power plant.

[6.0 Marks]

b) In a hydro power plant, 12 km^2 catchment area has an average annual rain fall of 1300 mm. The gross head of the power plant is 175 m and there is a head loss of 20%. The efficiency of the turbine and generator are estimated as 90% and 95% respectively. Take density of water as 1000 kgm^{-3} and gravitational acceleration as 9.81 ms^{-2}.

i) Calculate the water flow rate. State any assumptions you made.

ii) Calculate the average power output of the plant.

[4.0 Marks]

Q5 a) i) State three heat recovery systems associated with the boiler of a coal-fired steam power plant and briefly explain the function of one of them.

ii) Briefly describe the function of the following components of a nuclear power plant.

I. Primary coolant

II. Secondary coolant

III. Control rods

IV. Shield

iii) State two merits and demerits of steam power plants.

[6.0 Marks]

b) A coal power plant has a plant capacity of 300 MW and a thermal efficiency of 21%. The plant has an annual plant capacity factor of 0.6 and a peak demand of 260 MW. Take the calorific value of coal as 27200 kJ/kg.

i) Calculate the electrical energy produced over year.

ii) Calculate the annual coal requirement.

[4.0 Marks]

Table Q1

Time	Load (MW)
12 midnight - 6.00 a.m.	40
6.00 a.m. - 10.00 a.m.	50
10.00 a.m. - 12 noon	60
12 noon - 4.00 p.m.	50
4.00 p.m. - 8.00 p.m.	80
8.00 p.m. - 12 midnight	40