KATHMANDU UNIVERSITY
End Semester Examination
December 2024/January 2025

Marks Scored:

Level : B.E.
Year : IV

Course : EPEG 425
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No.:

Date : 09 JAN 2025

SECTION "A"
[20Q. × 0.5 = 10 marks]

Choose the most appropriate answer and **encircle**.

1. The amount of electrical energy that can be generated by a hydroelectric power plant depends upon
   a. Head of water
   b. Quantity of water
   c. Specific weight of water
   d. Efficiency of alternator

2. The use of surge tank in hydroelectric power plant is to
   a. Control the water flow rate
   b. Changing the water flow rate
   c. Counteract the sound of water
   d. Controlling the pressure change in the system

3. The main component of the Francis turbine that serves as the inlet for water to the turbine is
   a. Spiral casing
   b. Stay vane
   c. Runner blade
   d. Guide vane

4. Choose a correct option regarding the hydroelectric generation from the given statements
   Statement I: The main function of the surge tank is to reduce the water hammering effect in the penstock
   Statement II: Penstock s a conduit system for taking water from the intake works and forebay to the turbine
   a. Statement I: True, Statement II: True
   b. Statement I: False, Statement II: False
   c. Statement I: False, Statement II: True
   d. Statement I: True, Statement II: False

5. The type of turbine used in hydro-electric plant for a water head range of 70-500 meter is
   a. Pelton
   b. Kaplan
   c. Francis
   d. Propeller

6. A hydroelectric reservoir can supply water continuously at a rate of 100 $m^3/s$. the head is 75 m. the theoretical power that can be generated is _____ Watts
   a. 73.5
   b. 65.7
   c. 68.5
   d. 70.8

7. The correct expression for the electrical power generated by the hydroelectric power plant where w=specific weight of water, H=head, η=efficiency, Q=flow rate is
   a. 75×0.736 wQHη Watt.
   b. (7.5/0.736) × wQHη Watt
   c. 0.845 ×wQHη Watt
   d. 9.81 ×wQHη

8. In a jet type condensers
   a. Cooling water passes through tubes and steam surrounds them
   b. Steam passes through tubes and cooling water surrounds them
   c. Steam and cooling water mixes
   d. Steam and cooling water do not mix.

9. Rankine efficiency of a steam power plant
   a. Improves in summer as compared to that in winter.
   b. Improves in winter as compared to that in summer.
   c. Improves in both summer and in winter
   d. Is unaffected by any climatic conditions

10. Compounding of steam turbine is done for
   a. Reducing the workdone
   b. Increasing the rotor speed
   c. Reducing the rotor speed
   d. Balancing the turbine

11. Economizers increases boiler efficiency by
   a. 1-5%  b. 4-10%  c. 10-12%  d. 8-10%

12. As the size of thermal generating unit decreases, the capital cost per kW of installed capacity
   a. Increases
   b. Decreases
   c. Remains the same
   d. Might increase sometimes and decrease sometimes

13. In a thermal power plant the feed water coming to economizer is heating using
   a. High pressure steam
   b. Low pressure steam
   c. Direct heat in the furnace
   d. Flue gases

14. In a four stroke cycle, the minimum temperature inside the engine cylinder occurs at the
   a. End of suction stroke
   b. Beginning of exhaust stroke
   c. Beginning of suction stroke
   d. End of exhaust stroke

15. Heavy water in nuclear power plant is used as
   I. Fuel
   II. Coolant
   III. Moderator
   a. I and II only  b. II and III only  c. I, II and III  d. II only

16. The following method/s can be used to improve the thermal efficiency of open cycle gas turbine plant
   METHOD I: INTERCOOLONG
   METHOD II: REHEATING
   METHOD III: REGENERATION
   a. Method I and II only
   b. Method I and III only
   c. Method III only
   d. Method I, II and III

17. In a gas turbine, intercooler is placed
    a. before low pressure compressor.
    b. in between low pressure compressor and high pressure compressor.
    c. in between high pressure compressor and turbine.
    d. none of the mentioned

18. The components of a Steam Power Plant are
    a. Evaporator, Condenser, Boiler, Expansion valve.
    b. Evaporator, Condenser, Boiler, Turbine
    c. Boiler, Turbine, Condenser, Pump
    d. Boiler, Turbine, Pump, Expansion valve

19. In a fuel cell the _____ energy is converted into electrical energy.
    a. Mechanical b. Chemical c. Heat d. Sound

20. A diesel engine is _____ as compared to petrol engine, both running at rated load.
    a. equally efficient b. more efficient
    c. less efficient d. all of the mentioned

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SECTION "B"
[4 Q. × 10 = 40 marks]

*Attempt **ANY FOUR** questions.* Assume any suitable data if required.

1.

a. A single jet impulse turbine is required to drive a generator to develop 15,000 KW. The available head at the nozzle is 770m. Assuming electric generator efficiency 96%, impulse wheel efficiency 88%, coefficient of velocity for nozzle 0.98, mean bucket velocity 0.45 of jet velocity, outlet angle of the buckets 16 degrees and the relative velocity of the water leaving the buckets 0.87 of that at inlet, find
   i. The diameter of the jet
   ii. The flow in cumecs and
   iii. The force exerted by the jet on the buckets.
   iv. If the ratio of the mean bucket circle diameter to the jet diameter is not to be less than 10, find the best synchronous speed for generation at 50 cycles per second and the corresponding mean diameter of the runner.

[1.5+1.5+1.5+1.5=6]

b. The parameters for Upper Tamakoshi Hydro Power Plant has been provided as:
Head, H = 822m, Flow rate, Q = 66 $m^3/s$ and Power Output, P = 456MW
Specify which type of turbine is suitable for your particular design and obtain the required dimensions of turbine. [4]

2.

a. A power station has to supply load as follows: [4]

| Time | Load (MW) |
|---|---|
| 12 midnight to 6 am | 40 |
| 6 am to 10 am | 60 |
| 10 am to 6 pm | 120 |
| 6 pm to 10 pm | 180 |
| 10 pm to 12 midnight | 40 |

   i. Draw the load curve and find load factor.
   ii. Select number and size of generator units to supply this load, and find reserved capacity.

b. The following data refers to a proposed hydroelectric power plant. [3]
Available head = 150 m, catchment area = 550 sq. km, rainfall =250 cm/year, percentage of total rainfall utilized = 85%, penstock efficiency =90%, turbine efficiency = 96%, generator efficiency = 86%, load factor= 0.65.
   i. Calculate the power developed.
   ii. Suggest suitable turbine for the plant.

**P.T.O.**

EPEG 425
Formulasheet

$$Piston\ Speed = 2LN$$

$$cut\ off\ ratio,\ \rho = \frac{V_3}{V_2}$$

$$\eta = 1 - \frac{1}{\Upsilon}(r^{\Upsilon-1})\frac{\rho^{\Upsilon}-1}{\rho-1}$$

$$\Upsilon = \frac{C_p}{C_v}$$

$$PV^{\Upsilon} = Constant$$

$$W = \frac{P_2V_3 - P_1V_1}{1-\Upsilon}$$

$$Mean\ eff.\ pressure,\ P_m = (work/swept\ volume)$$

$$P_m = \frac{PV^{\Upsilon}[\Upsilon(\rho-1) - r^{\Upsilon-1}(\rho^{\Upsilon}-1)]}{(\Upsilon-1)(r-1)}$$

$$Mean\ force\ on\ piston,\ F_m = P_m \cdot A$$

$$Air\ standard\ efficiency,\ \eta = 1 - \frac{t_4 - t_1}{\gamma(t_3 - t_2)}$$

$$where\ \ \sigma = \frac{C_p}{C_v} = \frac{sp.heat\ at\ const.\ pressure}{sp.heat\ at\ const.\ vol}$$

$$compression\ ratio,\ r = \frac{v_1}{v_2}$$

$$cut-off\ ratio,\ \rho = \frac{v_3}{v_2} = \frac{vol.\ at\ cutoff}{clearance\ vol.}$$

$$\frac{t_2}{t_1} = r^{\gamma-1}$$

**Nuclear**

$$N = N_0 e^{-\lambda t}$$

$$Activity\ at\ time\ t,\ \ A = K\left(-\frac{dN}{dt}\right) = K\lambda N$$

$$A = K\lambda N_0 e^{-\lambda t}$$

$$A = A_0 e^{-\lambda t},\ where\ K\ is\ detection\ coefficient$$

$$K = \frac{\text{No. of neutrons in a particula generation}}{\text{No. of neutrons in the previous generation}}$$

$$t_{\frac{1}{2}} = \frac{\ln(2)}{\lambda}$$

$$Average\ life = \frac{1}{\lambda}$$

$$Fission\ rate\ of\ reactor = nc\sigma NV = \phi\sigma NV\ where$$

$$Power,\ P = \frac{nc\sigma NV}{3.1 \times 10^{10}}\ watt$$

$$n = avg.\ neutron\ density$$

$$c = avg.\ speed \in m/s$$

$$\phi = nc = avg.\ neutron\ flux$$

$$N = no.\ of\ fissile\ nuclei/m^3$$

$$\sigma = fission\ cross\ section\ in\ m^2$$

$$V = volume\ of\ nuclear\ fuel$$

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$$General\ Euler\ Head,\ H_e = \frac{(u_1 v_{w1} - u_2 v_{w2})}{g}$$

$$breadth\ ratio = \frac{B_1}{D_1}$$

$$Q_{francis} = \pi D_1 B_1 v_{f1}$$

**Pelton**

$$P = \gamma' QH$$

$$v_{jet} = C_v\sqrt{2gH}$$

$$v_{peripheral} = u_1 = \frac{\pi DN}{60}$$

$$realtive\ velocity,\ v_{r1} = v_{jet} - u_1$$

$$m = \frac{D}{d}$$

$$speed\ ratio = \frac{u_1}{v_{jet}}$$

$$no.\ of\ jets,\ n = \frac{Q}{q}$$

$$u_1 = C_{nbv} v_{jet}$$

$$v_{w1} = v_{w2} = K v_{r1},\ where\ K\ is\ coeff.\ of\ friction$$

$$Force\ on\ bucket,\ F = \rho Q(v_{w1} + v_{w2})$$

$$Work\ done\ on\ the\ runner,\ W_r = \rho Q(v_{w1} + v_{w2})u$$

$$Power\ developed\ by\ runner,\ P_r = \rho Q(v_{w1} + v_{w2})u$$

$$Euler\ Head.\ H_e = \frac{u}{g}[(v_1 - u)(1 - K\cos\beta')]$$

$$\eta_h = \frac{H_e}{H}$$

$$\eta_0 = \eta_h\eta_m = \frac{P}{\gamma' QH}$$

$$\eta_m = \frac{P}{\gamma' QH_e}$$

$$N_s = \frac{120f}{p}$$

$$\tau = \gamma' QH_e$$

$$where,\ \tau = \rho g$$

$$Bucket\ size:$$

$$Radial\ length = 2d - 3d$$

$$Axial\ width = 3d - 5d$$

$$Bucket\ Depth = 0.8d - 1.2d$$

$$no.\ of\ jets,\ n = \frac{D}{2d} + 15$$

$$Q = \frac{\pi d^2}{4} v_{jet} n$$

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**Kaplan & Francis**

$$\eta_h = \frac{H_e}{H} \quad | \quad \eta_m = \frac{P}{\gamma' QH_e}$$

$$Specific\ speed\ of\ propeller,\ \omega_s = \omega\frac{\sqrt{P/\rho}}{(gH)^{1.25}}$$

$$N_s = \frac{N\sqrt{P}}{H^{1.25}}$$

$$Mean\ diameter\ of\ blade,\ D = \frac{D_t + D_h}{2}$$

$$where\ D_t \rightarrow tip\ diameter\ \&\ D_h \rightarrow hub\ diameter$$

$$Flow\ ratio,\ \chi = \frac{v_f}{\sqrt{2gH}},\ where\ v_f \rightarrow flow\ velocity$$

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SECTION "A"

[20Q. × 0.5 = 10 marks]

Choose the most appropriate answer and **encircle**.

1. What is the primary goal of planning in technology management?
   a. Reduce operational costs
   b. Set objectives and devise strategies
   c. Eliminate competition
   d. Avoid decision-making

2. Which of the following is a qualitative forecasting method?
   a. Regression analysis
   b. Delphi method
   c. Time-series analysis
   d. Control charts

3. Technological forecasting helps in:
   a. Avoiding technological innovation
   b. Predicting future trends in technology
   c. Reducing project costs
   d. Minimizing decision-making time

4. Bounded rationality in decision-making indicates:
   a. Unlimited access to resources
   b. Decisions constrained by information and time
   c. Perfectly rational decision-making
   d. Avoidance of risk

5. Which is NOT a category of decision-making?
   a. Routine decisions
   b. Nonroutine decisions
   c. Strategic decisions
   d. Random decisions

6. Legal forms of organizations include all EXCEPT:
   a. Partnership
   b. Corporation
   c. Sole proprietorship
   d. Political entity

7. Delegation in management refers to:
   a. Assigning tasks and authority to subordinates
   b. Avoiding responsibility
   c. Centralizing decision-making
   d. Reducing team size

8. Which leadership theory focuses on situational factors?
   a. Trait theory
   b. Behavioral theory
   c. Contingency theory
   d. Transformational theory

9. Financial controls include:
   a. Budgeting
   b. Employee evaluations
   c. Team collaboration tools
   d. Delegation strategies

10. What is the first phase of a product lifecycle?
a. Growth b. Introduction c. Maturity d. Decline

11. Concurrent engineering focuses on:
a. Sequential development processes b. Simultaneous design and production processes
c. Eliminating stakeholder involvement d. Post-production improvements

12. Lean manufacturing is designed to:
a. Increase production costs b. Eliminate waste
c. Delay production timelines d. Complicate supply chains

13. Which is NOT a component of Total Quality Management (TQM)?
a. Customer focus b. Continuous improvement
c. Centralized authority d. Employee involvement

14. Which project planning tool uses nodes and arrows?
a. CPM b. PERT c. Gantt chart d. Fishbone diagram

15. What is a characteristic of an effective project manager?
a. Lack of technical expertise b. Strong communication skills
c. Avoiding decision-making d. Ignoring team input

16. Ethical dilemmas arise when:
a. Decisions have conflicting moral principles
b. Engineers follow a strict code of ethics
c. Projects have clear goals
d. Decisions are purely technical

17. Professional societies help engineers by:
a. Increasing work hours
b. Offering resources for professional development
c. Minimizing ethical responsibilities
d. Restricting certifications

18. Six Sigma focuses on:
a. Reducing product defects b. Increasing production speed
c. Eliminating employee training d. Ignoring process improvement

19. Whistle-blowing refers to:
a. Reporting unethical practices within an organization
b. Promoting internal collaboration
c. Reducing communication barriers
d. Ignoring organizational policies

20. Which type of maintenance ensures continuous production efficiency?
a. Preventive maintenance b. Corrective maintenance
c. Total Productive Maintenance d. Emergency maintenance

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SECTION "B"
[6 Q. × 4 = 24 marks]

Students are encouraged to give plausible reasoning for each question with relevant examples.

1. Discuss the importance of Engineering Management knowledge for engineers in the modern professional landscape. Additionally, analyze whether management qualifies as both an art and a science. Support your argument with examples.

2. Differentiate between Traditional Engineering and Concurrent Engineering. Additionally, explain the significance of the Bathtub Curve in Reliability Engineering.

3. A machine operates with the following parameters:
   **Mean Time Between Failures (MTBF):** 400 hours
   **Mean Time to Repair (MTTR):** 10 hours
   - Calculate the system **Availability**.
   - If the system operates for 8000 hours, how many failures are expected to occur during this period?

4. A manufacturing company notices frequent complaints about worker fatigue and a high defect rate in their product assembly line. The management is considering redesigning the workstations to reduce physical strain on workers and adopting **value engineering principles to reduce production costs without compromising quality.**
   **Question:**
   Based on the scenario, explain how ergonomic principles can help improve worker productivity and how value engineering can optimize production costs. Provide specific suggestions for each approach.

5. What is the difference between ISO 9000 and ISO 9001? Explain their relevance in quality management systems.

6. What are the four career stages defined by Dalon and Thompson, and how do they help professionals plan their career growth effectively?

7. Short Notes on any Two:
   a. Game theory and how it can be applied in Business world.
   b. Maslow's Hierarchy of Needs.
   c. CPM vs Pert

P.T.O.

## SECTION "C"

[2 Q. × 8 = 16 marks]

Attempt ***ANY TWO*** questions.

8. Financial ratios are essential tools for evaluating a company's performance and comparing it with industry peers. In today's competitive and transformative business environment, financial management knowledge is crucial for decision-making.
   a. Explain the purpose and components of a Balance Sheet, Income Statement, and Cash Flow Statement, providing relevant examples.
   b. Identify and discuss key financial ratios used for business valuation, explaining their significance and impact on organizational performance.

9. A technology company has developed an innovative AI-powered product to optimize supply chain operations, which is now ready to be launched into the market. The company has decided to involve engineers in both the marketing and service activities to ensure a successful launch and continuous customer satisfaction.

   **Question:**
   a. How can engineers contribute to the marketing process of introducing this new AI product into the market?
   b. Discuss the significance of engineers' involvement in post-sales support and service. How can they ensure the product's reliability and meet customer expectations?
   c. Considering the 4Ps of marketing (Product, Price, Place, Promotion), what challenges might arise during the marketing and service phases, and how can engineers address these challenges to ensure the product's success and customer satisfaction?

10. A company that manufactures Smart Thermostats buys them at the rate of Rs. 800 per unit and sells them at the rate of Rs. 1,200 per unit. The company expects to sell a maximum of 70 units per day, and the minimum number of units they can sell is 60 units per day. Any unsold units have no resale value. Based on this, prepare a payoff table and regret table to help decide how many units to order. The company needs to make decisions using the following criteria:
    a. **Optimistic Approach (Maximax)**
    b. **Pessimistic Approach (Maximin)**
    c. **Maximax Regret Criteria**