भारतीय वन सेवा परीक्षा......**2011**.........

Indian Forest Services Examination

D-VSF-L-NRA

AGRICULTURAL ENGINEERING
Paper I

| Time Allowed : Three Hours | Maximum Marks : 200 |

INSTRUCTIONS

Candidates should attempt Questions No. 1 and 5 which are compulsory, and any THREE of the remaining questions, selecting at least ONE question from each Section.

All questions carry equal marks.

Marks allotted to parts of a question are indicated against each.

Answers must be written in ENGLISH only.

Assume suitable data, if necessary, and indicate the same clearly.

Neat sketches may be drawn, wherever required.

SECTION A

1. Answer any *four* of the following, not exceeding 150 words for each :

   (a) Explain factors affecting erosion by water.　　*10*

   (b) Describe characteristics of the contour lines. Explain the procedure to conduct topographical survey of a watershed by direct contour method.　*10*

(c) Establish a relationship for width of bench terrace in terms of land slope, vertical interval and the riser inclination. 10

(d) Discuss the mechanics of wind erosion. 10

(e) Write plotting position method of frequency analysis and its use in soil and water conservation engineering. 10

2. (a) What is watershed ? Write major objectives of watershed management programmes. What available information would you like to collect before conducting field survey in a watershed for preparation of watershed plan ? 10

(b) Describe with the help of suitable diagrams three types of earth embankments. 10

(c) Describe with proper illustrations different types of drainage systems used in earth embankments. 10

(d) Discuss different phases of design procedure of permanent soil conservation structures. 10

3. (a) What are the reasons for inconsistency in rainfall record ? Explain the method of removing inconsistency in rainfall data. 10

(b) Explain the different methods of determining the average rainfall over a watershed due to a storm. Discuss the relative merits and demerits of the various methods. 10

(c) Define flood routing. Also describe the elements of flood routing. 10

(d) Design a parabolic shaped grassed waterway to carry a flow of 2·0 m³/sec down a slope of 4·0%. The maximum velocity of flow is 1·5 m/sec and a freeboard of 10 cm is recommended. Assume n = 0·04. *10*

4. (a) Write the procedure to determine the priority watersheds. *10*

(b) List elements used in object recognition in photo interpretations. *10*

(c) Enlist the techniques of air photo interpretation. *10*

(d) Discuss merits and demerits of conventional and remote sensing approach in watershed survey for its development. *10*

SECTION B

5. Answer any *four* of the following, not exceeding 150 words for each :

   (a) Discuss briefly about water conveyance, water application, water storage, water distribution and water use efficiency.   *10*

   (b) Define drainage coefficient. Describe different types of land requiring drainage.   *10*

   (c) What are main types of canal linings ? List advantages of having lining of irrigation canals.   *10*

   (d) Discuss different points to be considered for selection of site of farmstead.   *10*

   (e) Explain the stream flow measurement by area-velocity method.   *10*

6. (a) What is consumptive use ? Explain different methods of consumptive use measurement.   *10*

   (b) What do you understand by aeration of a weir ? Explain. Discuss standard conditions that must be observed for installing a weir.   *10*

   (c) An undisturbed soil sample was taken with core sampler from a field 36 hrs after irrigation when the moisture was at field capacity. The core sampler was 7·5 cm in diameter and 15 cm deep. The weight of the sampler with moist soil was 2·52 kg and weight of oven dry soil was 2·34 kg. The weight of core sampler was 1·34 kg. What is the available moisture holding capacity ?   *10*

(d) A tube-well is constructed in a confined aquifer. The discharge of the tube-well is 28 lit/sec. The thickness of the aquifer is 12·0 m and drawdown is 20·0 m. The coefficient of permeability of the aquifer material is 12 m/day and the radius of influence is 190 m. Calculate diameter of the well.. **10**

7. (a) The following data were obtained in determining the soil moisture content at successive depths in the root zone prior to applying irrigation water :

Depth of sampling, cm	Wt. of moist soil sample, gm	Oven dry weight of soil sample, gm
0 – 25	135	127
25 – 50	137	128
50 – 75	123	115
75 – 100	111	102

The bulk density of the soil in the root zone was 1·50 gm/cm^3. The available moisture holding capacity of soil was 17·8 cm/m depth. Determine

(i) The moisture content at the different depths in the root zone.

(ii) Moisture content in the root zone at the time of irrigation.

(iii) Net depth of water to be applied to bring moisture content to field capacity.

(iv) Gross irrigation requirement at estimated field irrigation efficiency of 70 percent. **10**

(b) How will you design a sprinkler irrigation system for a farm ? Explain. *10*

(c) Describe principal characteristics of a centrifugal pump. *10*

(d) Differentiate between : *10*

    (i) Water requirement and Irrigation requirement

    (ii) Crop water use efficiency and Field water use efficiency

    (iii) Evaporation and Consumptive use

    (iv) Confined and Unconfined aquifer

    (v) Infiltration and Percolation

8. (a) A pump directly driven with motor discharges water at the rate of 600 lit per minute. Water horsepower is 7. Pump efficiency is 60%. Frictional losses in the system are 12% of static head and the velocity head is 3% of static head. Motor efficiency is 80%. Determine : *10*

    (i) Static head

    (ii) Input horsepower to motor

    (iii) Kilowatt input to motor

(b) How can you distinguish between sands with or without organic matter ? Explain.   *10*

(c) What is slump test on concrete ? What is its significance in building construction ?   *10*

(d) Write causes for development of salinity and alkalinity in the soils.   *10*

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AGRICULTURAL ENGINEERING

Paper—II

Time Allowed : Three Hours | Maximum Marks : 200

INSTRUCTIONS

Candidates should attempt Question Nos. 1 and 5 which are compulsory, and any THREE of the remaining questions selecting at least ONE question from each Section.

All questions carry equal marks.

Marks allotted to each part of a question are indicated against each.

Answers must be written in ENGLISH only.

Assume suitable data if considered necessary and indicate the same clearly in your answer.

Unless indicated otherwise, symbols, notations and abbreviations have their usual meanings.

SECTION—A

1. Answer any **FOUR** questions (not exceeding **150** words each) :— 10×4=40

   (a) In spite of a rapid increase in tractor and mechanical power in Indian farms during the last decade, the food productivity scenario has not improved as expected. Give your comments.

   (b) Calculate the theoretical power extracted by a horizontal axis wind rotor of 5 m diameter operating in a wind regime with wind velocity of 15 km/h. Take air density as 1.29 kg/m^3.

   (c) Differentiate between the following pairs in brief :

      (i) Indirect injection (IDI) and direct injection (DI) diesel engines for automotive applications.

      (ii) Traction wheel and towed wheel.

   (d) A field sprayer having a horizontal boom with 20 nozzles spaced 40 cm apart is to be used for a maximum application rate of 650 litres/ha at nozzle pressure of 500 kPa and forward speed of 5 km/h. Determine the required pump capacity in litres/min

assuming 10 per cent of the flow is bypassed under the above maximum conditions.

(e) Explain with a diagram the transmission of power from engine to the ground drive components in a crawler tractor. Why are these tractors more suitable on undulating terrains as compared to wheel tractors ?

2. (a) A 2-wheel drive tractor was tested on a farm surface and the following data were recorded :

Drawbar pull = 26·2 kN,

distance travelled for 10 revolutions of driving wheels at no load = 55·8 m,

distance travelled for 10 revolutions of driving wheels at load = 46·2 m,

fuel consumed = 126 g, and

time taken = 25·8 seconds

Determine the following :—

(i) drawbar power developed

(ii) per cent wheel slip

(iii) drawbar specific fuel consumption.   15

(b) Explain the working of a power operated thresher used for wheat crop giving the recommended range of cylinder peripheral speed and type of threshing element. Write down the

(Contd.)

expressions to evaluate the threshing efficiency and cylinder loss. 15

(c) A single-phase 230 V electric motor running at 1400 rpm develops a torque of 3·1 Nm. Calculate the amount of electric current drawn by the motor, if the phase angle between the voltage and current is 38° and the power efficiency of the motor is 80 per cent. 10

3. (a) Explain the mechanism of anaerobic fermentation of organic solids. Suggest the optimum range of the following operating parameters for increased biogas production :

(i) solid concentration,

(ii) pH of slurry,

(iii) carbon-to-nitrogen ratio,

(iv) digester temperature, and

(v) retention period. 15

(b) With a schematic diagram explain the fuel supply system in a tractor diesel engine. Name the two types of injector nozzles with their applications in diesel engines. 15

(Contd.)

(c) A four-cylinder, four-stroke cycle diesel engine operates at 2000 rpm and uses 7·5 litres of fuel per hour. What is the average volume in millilitres of individual injections ? 10

4. (a) A 2-wheel drive tractor engine develops 22·5 kW at 2000 rpm. The drive passes via a gearbox which has a ratio of 5·78 : 1 engaged, a differential reduction of 4 : 1 and a final drive reduction of 5 : 1. Determine the speed, torque and power delivered to a single driving wheel of the tractor if it is moving in a straight line and the overall transmission efficiency is 80 per cent. 15

(b) A self propelled combine with an 8-row corn head for 75 cm row spacing travels at 4 km/h. Loss of time proportional to area equals 8 min/ha and this is primarily due to the unloading of the grain from the combine. If the other losses are neglected, determine on an area basis, (i) the theoretical field capacity, and (ii) the actual field capacity. 10

(c) With a simple schematic diagram explain the working of a tractor drawn cut-and-throw type forage harvester having a cylindrical cutter head. How do you determine the capacity of this machine ? 15

SECTION—B

5. Write brief notes on any **FOUR** of the following (not exceeding **150** words each) :— 10×4=40

   (a) Linear Variable Differential Transformer (LVDT)

   (b) Deep bed drying

   (c) Hammer mill

   (d) Homogenization of milk

   (e) Rubber roll husker.

6. (a) Draw a block diagram showing the operations performed from receiving to final storage in a modern rice mill. Explain the basic purpose of each operation in brief. 15

   (b) A bin holds 2000 kg of wet grain containing 500 kg of water. This grain is to be dried to a final moisture content of 14 per cent (wet basis).

   (i) What are the initial and final moisture contents of grain on dry basis ?

   (ii) How much water is removed during drying ? 15

   (c) What is a thermistor ? Explain the temperature - resistance function of a thermistor. 10

7. (a) A Wheatstone bridge circuit uses a strain gauge of 120 Ω resistance with gauge factor of 2·05 in each of its arms where only one of the gauges is active. The active gauge is mounted on a mild steel bar which undergoes a strain of 4×10^{-4}. If the excitation supply voltage is 5 V, determine the bridge output. 15

(b) With a schematic diagram explain the working of a vapor compression refrigeration system commonly used in dairies. 15

(c) What are the desirable qualities of packaging materials for milk and ice cream ? 10

8. (a) A tractor mounted fertilizer applicator is to be used with an electronic sensor and a microprocessor based data acquisition system to apply desired quantity of fertilizer at different locations in a standing crop. Show the schematic design including the various elements of the system and explain its functioning. 15

(b) With a diagram explain the working principle of a Pitot tube to measure the velocity of a gas flowing through a pipe. What is the major drawback with the Pitot tube ? 10

(c) Draw schematic diagram of a screw conveyer and label the components. A horizontal screw conveyer of length 2 m conveys wheat grain having bulk density of 680 kg/m³. The screw diameter, shaft diameter and pitch length of the screw are 0·50 m; 0·30 m, and 0·45 m respectively. If the screw is completely filled with the grain and rotates at 60 rpm, determine the capacity of the screw conveyer in kg/h.   15