# GUJARAT TECHNOLOGICAL UNIVERSITY

6th Semester Civil Engineering - PDDC

**Subject Code & Name:** X60603 - Irrigation Engineering

| Sr. No. | Course content |
|---|---|
| 1. | **General:**<br>Introduction, definition, necessity of irrigation, scope and benefits, ill effects of irrigation, irrigation development in India. |
| 2. | **Methods of Irrigation:**<br>Introduction, comparison of various irrigation methods viz. farm flooding, lift drip, sprinkler, micro irrigation methods like subsurface pitcher irrigation etc., irrigation rates, riparian rights, principles of assessing water rates. |
| 3. | **Irrigation Water:**<br>Soil, crops and water requirements of crops. Duty and delta. Assessment of irrigation water. Methods of applying water to crops, water logging problems, causes and remedial measures. |
| 4. | **Diversion Works:**<br>Introduction, types of diversion head work, causes of failure, Bligh's, Lane's and Khosla's theory, design of glacis weir, design of vertical weir, silt control devices, Appurtenances – fish ladder, divide wall, under & scouring sluices, canal head regulator. |
| 5. | **Earthen Dams:**<br>Types of earthen dams, details, causes of failure of earth dam, seepage line, flow net, stability analysis of slopes, seepage control, safety against piping, slope protections, design considerations in earthquake region, measures of safe drainage |
| 6. | **Gravity Dams:**<br>Introduction, forces acting on dam, load combination for design, various stresses at any horizontal plane, middle third rule, failures of dam, stability requirements, elementary and practical profiles of dam, openings in dam, foundation treatment, spillway, capacity of spillway, components, types, factors affecting design, design criteria, energy dissipation on d/s side of spillway, stilling basins, bucket type dissipaters, spillway gates. |
| 7. | **Canals:**<br>Alignment and types of canals, design consideration, Lacey's & Kennedy's theories, canal lining, canal losses and maintenance, canal regulators, falls, escapes, outlet, constructional features, CD works, Aqueducts, super passages, syphon, level crossing with principles of hydraulic design. |

**Term Work:** Nil

**Field Visit:** Field visits based on course content are suggested

**References Books:**


1. Irrigation & Water Power Engineering - Dr. B.C.Punmia & B.B.Pande
2. Irrigation, Water Resources & Water Power Engineering - Dr. P.N.Modi
3. Irrigation, Water Power & Water Resources Engineering - Dr. K.R.Arora
4. Irrigation and Hydraulic Structures - S.K.Garg

Seat No.: _____ Enrolment No._____

# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VI EXAMINATION – WINTER 2015**

**Subject Code:X60603 Date:12/12/2015**

**Subject Name: Irrigation Engineering**

**Time: 02:30pm to 05:00pm Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Define irrigation and explain in detail irrigation development in India. | **07** |
| | **(b)** | Classify irrigation methods and explain sprinkler irrigation in detail. | **07** |
| **Q.2** | **(a)** | Explain the term 'Duty' and 'Delta'. Derive relationship between the two. | **07** |
| | **(b)** | A water course has a culturable commanded area of 1000 hectares. The intensity of crop A is 20% and crop B is 40%. Kor period for crop A and crop B is 18 days and 15 days respectively. Kor depth for crop A is 15 cm and for crop B kor depth is 18 cm. Calculate the discharge of the water required. | **07** |
| | | **OR** | |
| | **(b)** | Explain 'Assessment of irrigation water'. Describe any two methods of assessment in detail. | **07** |
| **Q.3** | **(a)** | Draw a neat sketch to show components of a diversion headwork and explain each component. | **07** |
| | **(b)** | Explain the method of drawing phreatic line for an earth dam with horizontal filter at downstream. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Compare Bligh' Creep theory and Lane's Weighted theory. | **07** |
| | **(b)** | Give criteria for safe design of earthen dam. | **07** |
| **Q.4** | **(a)** | Show forces acting on a gravity dam with neat sketch. | **07** |
| | **(b)** | What is a spillway? Explain component parts of a spillway. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Describe graphical method of stability analysis of dam. | **07** |
| | **(b)** | What is distributary head regulator? Explain its function. | **07** |
| **Q.5** | **(a)** | Explain Kennedy's silt theory. | **07** |
| | **(b)** | Define canal lining. Explain necessity and advantage of canal lining. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | What is a canal fall. Enumerate types of canal fall and explain any one type of fall in detail. | **07** |
| | **(b)** | Define cross drainage work. Explain types of aqueducts with the help of neat sketches. | **07** |

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VI • EXAMINATION – SUMMER • 2015**

**Subject Code: X60603** **Date: 12/05/2015**

**Subject Name: IRRIGATION ENGINEERING**

**Time: 10:30 am - 01:00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | What is Irrigation and explain the necessity of irrigation. | **07** |
| | **(b)** | Discuss briefly the benefits as well as ill-effects of irrigation. | **07** |
| **Q.2** | **(a)** | Enlist the various methods of irrigation and explain any one in detail. | **07** |
| | **(b)** | Explain briefly the merits and demerits of drip irrigation. | **07** |
| | | **OR** | |
| | **(b)** | Explain briefly the merits and demerits of Sprinkler irrigation. | **07** |
| **Q.3** | **(a)** | Derive a relationship between Duty and Delta. Explain the factors affecting Duty. | **07** |
| | **(b)** | What is water logging? Discuss the effects and remedial measures of water logging. | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Compare Bligh's creep theory and Lanes weighted creep theory. | **07** |
| | **(b)** | Find the field capacity of a soil for the following data: -<br>Root zone depth = 2 m<br>Existing water content = 5 %<br>Dry density of soil = 1.5 g/cm^3<br>Water applied to the soil = 500 $m^3$<br>Water loss due to evaporation etc. = 10%<br>Area of plot = 2000 sq.metres. | **07** |
| **Q.4** | **(a)** | Discuss the various types of Earth dams. | **07** |
| | **(b)** | Enlist the various types of spillway. Describe any one in detail. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Enlist the various forces acting on a gravity dam. Explain any one in detail. | **07** |
| | **(b)** | Enlist the various components of a Diversion headwork. Explain any one in detail. | **07** |
| **Q.5** | **(a)** | Explain different types of buckets used for energy dissipation. | **07** |
| | **(b)** | The slope of a channel in alluvium is S = 1/5000. Lacey's silt factor = 0.9. Channel side slope = 0.5/1. Find the channel section and maximum discharge which can be allowed to flow in it. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | What are the advantages and disadvantages of the canal lining | **07** |
| | **(b)** | Differentiate between (a) aqueduct and syphon aqueduct (b) super passage and canal syphon. | **07** |

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VI • EXAMINATION – WINTER • 2014**

**Subject Code: X 60603** **Date: 04-12-2014**

**Subject Name: Irrigation Engineering**

**Time: 02:30 pm - 05:00 pm** **Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Discuss briefly the benefits as well as the ill-effects of irrigation. **07**

**(b)** What are the different types of irrigation systems? Discuss each of these systems briefly. **07**

**Q.2** **(a)** Discuss the various sub-surface irrigation methods. Indicate their limitations. **07**

**(b)** Find the field capacity of a soil for the following data **07**

(i) Depth of root zone = 2 meter
(ii) Existing water content = 5 %
(iii) Dry density of soil = 1500 kg/$m^3$
(iv) Water applied to soil = 600 $m^3$
(v) Water lost due to evaporation and deep percolation = 10 %
(vi) Area of land irrigated = 900 $m^2$.

**OR**

**(b)** The gross commanded area for an irrigation canal is 20000 hectares out of which 75 % is culturable commanded area. The intensity of irrigation is 40 % for rabi and 10% for rice. If kor period is 4 weeks for rabi and 2.5 weeks for rice, determine the outlet discharge, outlet factors for rabi and rice may be assumed as 1800 hectares/cumecs and 775 hectares/cumecs. Also calculate delta for each course. **07**

**Q.3** **(a)** Discuss briefly the factors affecting the choice of the method of irrigation. **07**

**(b)** Describe in detail sprinkler method of irrigation. Indicate the advantages and limitations of the method. **07**

**OR**

**Q.3** **(a)** The base period , intensity of irrigation and duty for various crops under a canal system are given in the table below. Determine the reservoir capacity if the culturable commanded area is 40000 hectares, canal losses are 20 % and reservoir losses are 10 %. **07**

| crop | Base period ( days) | Duty of water at the field ( hectares/cumec) | Intensity of irrigation ( % ) |
|---|---|---|---|
| Wheat | 120 | 1800 | 20 |
| Sugarcane | 360 | 1700 | 20 |
| Cotton | 180 | 1400 | 10 |
| Rice | 120 | 800 | 15 |
| vegetables | 120 | 700 | 15 |

**(b)** After how many days will you order irrigation in order to ensure healthy growth of crops, if **07**

(i) Field capacity of soil = 29 %
(ii) Permanent wilting percentage = 11 %
(iii) Density of soil = 1300 kg/m3
(iv) Effective depth of root zone = 700 mm
(v) Daily consumptive use of water for the given crop = 12 mm.

For healthy growth moisture content must not fall below 25 % of the water holding capacity between the field capacity and the permanent wilting point.

**Q.4** **(a)** Differentiate between a permanent canal and a inundation canal. **07**

**(b)** Distinguish between a ridge canal and a contour canal. **07**

**OR**

**Q.4** **(a)** Design an irrigation channel to carry a discharge of 5 cumecs. Assume N = 0.0255 and m =1. The channel has a bed slope of 0.2 meter per kilometer. **07**

**(b)** A canal has a bed width of 8 m full supply depth 2.5 m, bank width 3m, cutting slope 1:1, filling slope1.5:1 and free board 0.5 m calculate balancing depth. **07**

**Q.5** **(a)** Discuss the various measures which may be taken to prevent water logging as well as to relive the land already water logged. **07**

**(b)** Write a note on economics of channel linning. **07**

**OR**

**Q.5** **(a)** What is canal escape? what are the different types of canal escapes? **07**

**(b)** What is a cross regulator? what are the functions of a cross regulator? **07**

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER– VI • EXAMINATION – SUMMER 2014**

**Subject Code: X60603 Date: 03-06-2014**

**Subject: Irrigation Engineering**

**Time: 10.30 am to 01.00 pm Total Marks: 70**

**Instructions:**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Give the differences between, Bligh's theory, Lane's theory and Khosla's theory | **07** |
| | **(b)** | Highlight the advantage, suitability mechanism for pitcher irrigation | **07** |
| **Q.2** | **(a)** | Draw longitudinal section of a vertical drop weir and describe the function of each component | **07** |
| | **(b)** | Draw a section through ski jump bucket type of spill way to describe its suitability and energy dissipation mechanism with salient features. | **07** |
| | | **OR** | |
| | **(b)** | State the design considerations of earthen dams in earthquake regions. | **07** |
| **Q.3** | **(a)** | Draw plan and sectional view of a fish ladder to explain its working and discuss its importance in relation to fish migration trends. | **07** |
| | **(b)** | Give the classification of canals based on alignment .Give the relative advantage of each type of alignment | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | Draw a proportionate sketch of an aquaduct. Analyze the hydraulic forces acting on the side and bottom of the siphon aquaduct. | **07** |
| | **(b)** | (i)Discuss the necessity of irrigation in monsoon type of climate .<br>(ii)Analyze the development of irrigation in modern India. | **07** |
| **Q.4** | **(a)** | Draw section of a non homogeneous type of earthen dam and describe the components | **07** |
| | **(b)** | A field channel has a culturable command area of 2000 hectares. The intensity of irrigation for gram is 30% and that for wheat is 50%. Gram has kor period of 18 days and kor depth of 12 cm, while wheat has a kor period of 15 days and kor depth of 15 cm. Calculate the discharge of the field channel. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Explain the various stability tests that are to be applied to the trial section of practical profile of gravity dam | **07** |
| | **(b)** | A siphon spill way has a throat height 1.5 meter and width of 4 meter. At the design flow the effective head causing the flow is 2 meter. Taking the coefficient of discharge as 0.6 determine the capacity of the siphon. Determine the head that would be required on an ogee spillway 4 meter long to discharge this flow if coefficient of discharge is 2.25 | **07** |
| **Q.5** | **(a)** | Explain and develop the middle third rule for elementary profile of a gravity dam | **07** |
| | **(b)** | The discharge available from a tube well is 120 $m^3$/ hour. Assuming 3200 hours of working from a tube well in a year estimate the culturable area that the tube well will command. The intensity of irrigation is 50% and the average depth of irrigation is 48 cm. | **07** |
| | | **OR** | |

**Q.5** **(a)** Draw section of a gravity dam showing the shafts ,galleries and sluices provided in the section and state their functions. **07**

**(b)** (i)State the disadvantage of canal lining **07**

(ii) Given the value of limiting velocity 'V' the rugosity coefficient 'N' and the longitudinal slope 'S' give the steps for design of a lined canal trapezoidal section.

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VI • EXAMINATION – WINTER 2013**

**Subject Code: X60603** **Date: 09-12-2013**

**Subject Name: Irrigation Engineering**

**Time: 02.30 pm - 05.00 pm** **Total Marks: 70**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

**Q.1** **(a)** Discuss briefly the benefits of irrigation **07**

**(b)** What are the types of irrigation systems ? Discuss each of these systems briefly. **07**

**Q.2** **(a)** Discuss briefly the factors affecting the choice of the irrigation methods. **07**

**(b)** Find the field capacity of a soil for the following data : **07**
( I ) Depth of root zone = 2 meter
( ii ) Existing water content = 5 %
( iii ) Dry density of soil = 1500 kg/cubic meter
( iv ) Water applied to soil = 600 cubic meter
( v ) Water lost due to evaporation and deep percolation = 10 %
( vi ) Area of land irrigated = 900 square meter.

**OR**

**(b)** A loam soil has field capacity 25 % and permanent wilting percentage 10 %.The dry unit weight of soil is 14.72 kN/cubic meter. If the depth of the root zone is 0.75 meter, determine the storage capacity of the soil. Irrigation water is applied when moisture content drops to 14 %. If water application efficiency is 75 % , determine the water depth required to be applied in the field. **07**

**Q.3** **(a)** Explain how soil properties affect the irrigation requirement. **07**

**(b)** Describe with the help of sketch various forms of soil moisture. Which of these soil moistures is mainly available for utilization by the plants ? **07**

**OR**

**Q.3** **(a)** Distinguish between ( I ) ridge canal and contour canal. ( ii ) productive and protective canal. **07**

**(b)** Discuss in detail the various causes of losses of water in channels. **07**

**Q.4** **(a)** Explain the terms ‘duty’ and ‘delta’. Derive a relationship between the two for a given base period. **07**

**(b)** What is consumptive use of water? Describe any two methods for determining the consumptive use of water. **07**

**OR**

**Q.4** **(a)** Determine the dimensions of the irrigation canal for the following data : ( B/D) ratio = 3.7 ; **07**
Rugosity coefficient N = 0.0225 ;
critical velocity ratio m = 1.0 ; and
bed slope S = ( 1/4000).
Side slope of the channel is 0.5 horizontal to 1 vertical.
Also determine the discharge which will be flowing in the channel.

**(b)** Discuss the drawbacks of kennedy’s theory. **07**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | Discuss the various measures which may be taken to prevent water logging as well as to relieve the land already waterlogged. | **07** |
| | **(b)** | Write a note on economics of channel linning. | **07** |

**OR**

| | | | |
|---|---|---|---|
| **Q.5** | **(a)** | What is level crossing ? | **07** |
| | **(b)** | What is a barrage ? how does a barrage differ from a weir. | **07** |

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# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC - SEMESTER–VI • EXAMINATION – SUMMER 2013**

**Subject Code: X60603 Date: 07-06-2013**

**Subject Name: Irrigation Engineering**

**Time: 10.30 am - 01.00 pm Total Marks: 70**

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Classify the methods of surface irrigation and discuss any one in detail. | **07** |
| | **(b)** | Compare drip irrigation with sprinkler irrigation. | **07** |
| **Q.2** | **(a)** | Discuss the causes of failure of earthen dam. | **07** |
| | **(b)** | Explain duty and Delta. | **07** |
| | | **OR** | |
| | **(b)** | Discuss the causes of water logging. | **07** |
| **Q.3** | **(a)** | What are modes of failure of a gravity dam? Discus them. | **07** |
| | **(b)** | How will you calculate silt pressure and water pressure acting on a gravity dam? | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | What is phreatic line? How will you locate it on an earthen dam? | **07** |
| | **(b)** | Discuss the forces acting on a gravity dam. | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Write short note on a Canal Head Regulator. | **07** |
| | **(b)** | What is spillway? What are its component parts? | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | Explain Khosla's method of Independent Variables. | **07** |
| **Q.4** | **(b)** | Explain Irrigation efficiencies in detail. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | How the salinity in the coastal area can be prevented? | **07** |
| | **(b)** | Compare Bligh' Creep theory and Lane's Weighted theory. | **07** |
| | | **OR** | |
| **Q.5** | **(a)** | Discuss the limiting height of a low gravity dam. | **07** |
| | **(b)** | How the saline land can be reclaimed? | **07** |

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*Seat No.: _____* *Enrolment No._____*

# GUJARAT TECHNOLOGICAL UNIVERSITY

**PDDC-Semester –VI (May-2012) Examination**

**Subject code: X60603**

**Subject Name: Irrigation Engineering**

**Date:10 /05/2012**

**Time: 10.30 am – 01.00 pm** **Total Marks: 70**

## Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

| | | | |
|---|---|---|---|
| **Q.1** | **(a)** | Define Irrigation and explain the factors which necessitate irrigation | **07** |
| | **(b)** | Discuss briefly the benefits as well as ill-effects of irrigation | **07** |
| **Q.2** | **(a)** | Classify the irrigation methods and explain any one briefly | **07** |
| | **(b)** | Find the field capacity of a soil for the following data (i) Depth of root zone =2 metre, (ii) Existing water content = 6 % , (iii) Dry density of soil = 1400 kg/cubic metre, (iv) Water applied to soil = 500 cubic metre (v) Water lost due to evaporation and deep percolation=10 % (vi) Area of land irrigation = 1000 square metre. | **07** |
| | | **OR** | |
| | **(b)** | A water course has a culturable commanded area of 1000 hectares. The intensity of irrigation for crop A is 40 % and for crop B is 45 % , both the crops being rabi crops. Crop A has a kor depth of 150 mm and kor period 3 weeks and Crop B has a kor depth of 100 mm and kor period 2 weeks. Calculate the discharge of the water course. | **07** |
| **Q.3** | **(a)** | What is a gravity dam ? Enumerate the various forces acting on a gravity dam. | **07** |
| | **(b)** | Discuss the various purposes for which galleries are provided in dams | **07** |
| | | **OR** | |
| **Q.3** | **(a)** | What are the different types of earth dams ? Support your answer with neat sketches | **07** |
| | **(b)** | A 100 m high concrete gravity dam trapezoidal in cross-section has upstream face vertical, crest width 6 m , base width 75 m and free board equal to 4 m. Calculate the maximum and minimum vertical stress at the toe and heel. When the reservoir is full. Take unit weight of concrete as 23.544 KN/cubic m. Neglect all other forces except hydrostatic water pressure, uplift pressure and self weight. There is no drainage gallery and no tail water. | **07** |
| **Q.4** | **(a)** | What are the different types of canals ? And how canals are classify according the canal alignment. Explain with sketch. | **07** |
| | **(b)** | What are the advantages and disadvantages of the canal lining | **07** |
| | | **OR** | |
| **Q.4** | **(a)** | What are the factors affecting duty? How can duty be improved. | **07** |
| | **(b)** | What is a fall in a canal ? Why is it necessary to provide a fall in a canal. Describe briefly with neat sketches the different types of falls. | **07** |
| **Q.5** | **(a)** | What is a spillway ? What are its essential requirements. Describe the various components of a spillway. | **07** |
| | **(b)** | Sketch the layout of a typical diversion headworks and describe briefly the | **07** |

functions of the various components of diversion headworks.

**OR**

**Q.5** **(a)** Differentiate between (a) aqueduct and syphon aqueduct (b) super passage and canal syphon. **07**

**(b)** What is water logging ? What are the ill effects and causes of water logging. **07**

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