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SIES

College of Arts, Science & Commerce

RISE WITH EDUCATION

Sion (West), Mumbai – 400022

# (Autonomous)

## Faculty: Science

## Program: T.Y.B.Sc.

## Subject: FISHERY BIOLOGY

**(APPLIED COMPONENT)**

**Academic Year: 2018 – 2019**

**Credit Based Semester and Grading System approved by Board of Studies in Zoology to be brought into effect from June 2018**

# T.Y.B.Sc. Fishery Biology (Applied Component) Syllabus (Autonomous)

**Semester V and Semester VI**

**(Credit Based Semester and Grading System, with effect from academic year 2018-19)**

## *Preamble*

*"Faith is a bird that feels the light and sings while the dawn is still dark."– Rabindranath Tagore*

*Academic Autonomy entitles the institution with certains privileges, one of them being freedom to prescribe our own course and curriculum, and refine it to make it locally relevant. This academic freedom is a milestone for academic excellence. Thus, a revision of the syllabus is necessitated to give a competitive edge to the students to sustain themselves in this fast moving world.*

*The aim of introducing Applied Component in T.Y.B.Sc. program is to fuel the entrepreneurial potential of students. This may encourage those zoologists with a flair for business, to acquire an in depth knowledge of the subject for its applicability to earn a livelihood. Fishery Biology, an application of Zoology mainly concerns with the wealth of aquatic natural resources i.e., fish and other organisms living in water, that can yield economic benefits. It is concerned with management of fish stocks for commercial food production, one of the ways to eradicate malnutrition. It also involves the study of ecological aspects related to aquaculture and conservation of threatened aquatic species.*

*A collective effort of the professors of Zoology at SIES College, Sion (West) and other board members from outside the institution has helped in conceptualizing this syllabus. It was approved by the Board of Studies (Ad hoc) in the meeting held on 16$^{th}$ June 2018 at the institution's department of Zoology.*

*This course in Fishery Biology is our approach to expose students to the research in fishery science and also to develop managerial skills among them.*

*Dr. Satish Sarfare*
*Chairman,*
*Board of Studies in the subject of Zoology*

**T.Y.B.Sc. Fishery Biology (Applied Component) Syllabus (Autonomous)**
**Credit Based Semester and Grading System**
**(With effect from academic year 2018-19)**

## Grid of Syllabus –Semester V

| Theory (Any four units to be opted) | | | | |
|---|---|---|---|---|
| **Paper Code** | **Unit No.** | **Unit Name** | **Credits** | **Lectures/week** |
| **SIUSACFBIO51**<br><br>**(Oceanography, Aquaculture Practices, Marketing and Finance)** | 1 | Oceanography | 2 | 4 |
| | 2 | Crafts and Gears | | |
| | 3 | Farming of Major Carps | | |
| | 4 | Introduction to other Commercial Aquaculture Practices in Fresh Water | | |
| | 5 | Brackish water prawn *Penaeus monodon* culture | | |
| | 6 | Introduction to other Commercial Aquaculture in Brackish Water/ Marine Water | | |
| | 7 | Quality control and Packaging | | |
| | 8 | Marketing and Finance | | |
| **Practical** | | | | |
| **SIUSACFBIOP51** | Based on SIUSACFBIO51 | | 2 | 4 |
| **Total** | | | **4** | **8** |

## Grid of Syllabus –Semester VI

| Theory (Any four units to be opted) | | | | |
|---|---|---|---|---|
| **Paper Code** | **Unit No.** | **Unit Name** | **Credits** | **Lectures/week** |
| **SIUSACFBIO61**<br><br>**(Marine resources, Post-harvest and Farm Engineering)** | 1 | Marine Fin fish of India | 2 | 4 |
| | 2 | Marine Shell fish of India | | |
| | 3 | Nutrition | | |
| | 4 | Diseases | | |
| | 5 | Preservation and Processing | | |
| | 6 | By-products and Value added Products | | |
| | 7 | Farm Engineering | | |
| | 8 | Introduction to other Aquaculture Practices | | |
| **Practical** | | | | |
| **SIUSACFBIOP61** | Based on SIUSACFBIO61 | | 2 | 4 |
| **Total** | | | **4** | **8** |

**Semester V – Theory**

**Paper code: SIUSACFBIO51**
**Oceanography, Aquaculture Practices, Marketing and Finance**
(Any four units to be opted)

***Learning Objectives***

- *To introduce the basic concepts of Oceanography and to learn about the various tools used in oceanographic studies.*
- *To know about the crafts and gears employed in fishery.*
- *To learn about the farming techniques involved in culturing commercially important fish/ crustaceans of fresh water, brackish water and marine water.*
- *To understand the importance of quality control and proper packaging in fishery to increase the shelf life of the products.*
- *To become familiar with the commerce aspect in fishery science.*

**Unit 1: Oceanography** **Lectures 15**

1.1: Navigational and sea safety equipments – Life saving devices, global positioning system, radar, signalling devices
1.2: Oceanographic Instruments – Nansen's reversing bottle, Peterson's grab, dredges, fish finding instruments/ methods, remote sensing
1.3: Introduction to basic physical, chemical and biological oceanography

**Unit 2: Crafts and Gears** **Lectures 15**

2.1: Basic boat building (Parts, Design, Materials used), Methods of protection from foulers and borers
2.2: Basic studies of marine engines – Outboard and inboard engines, sectional view of 2 stroke and 4 stroke diesel engines, winch and deck side equipments
2.3: Operations – Gill, Trawl, Purse seine nets, Hooks and lines, Turtle exclusion device (TED), Non conventional fishing methods such as light fishing, hose pipe fishing, electric fishing

**Unit 3: Farming of Major Carps** **Lectures 15**

3.1: Breeding techniques of Major Carps and Common Carps
3.2: Hatchery and Nursery Management of Indian Major Carps –*Labeo rohita, Catla catla, Cirrhina mrigala* and Exotic carps – Common Carp: *Cyprinus carpio,*
Silver Carp: *Hypopthalamichthyes molyxtrics,* Grass Carp: *Ctenopharyngodon idella*
3.3: Monoculture and polyculture practices – Extensive, Semi-intensive and Intensive

**Unit 4: Introduction to other Commercial Aquaculture Practices in Fresh Water**
**Lectures 15**

4.1: Fresh water prawn –*Macrobrachium rosenbergii* - Breeding, life cycle, hatchery management and rearing, Composite culture
4.2: Ornamental fishes – Breeding and rearing of *Danio,* Angel, Discus, Neon Tetra, Red Sword Tail, Flower Horn, Siamese Fighter

4.3: Air Breathing Fishes – Breeding and rearing

**Unit 5: Brackish water prawn *Penaeus monodon* culture** **Lectures 15**

5.1: Breeding techniques
5.2: Hatchery and Nursery Management
5.3: Rearing practices – Extensive, Semi-intensive, Intensive and Sustainable

**Unit 6: Introduction to other Commercial Aquaculture in Brackish/ Marine water**
**Lectures 15**

6.1: Fin fish culture – *Lates calcarifer*
6.2: Crab – *Scylla serrata*
6.3: Pearl – *Pinctada vulgaris*

**Unit 7: Quality Control and Packaging** **Lectures 15**

7.1: Post mortem changes and mechanism of spoilage – Hyperaemia, Rigor Mortis, Autolysis, Rancidity
7.2: Brief methods for evaluating freshness and quality (Organoleptic, Microbial and Chemical) of fish and prawn
7.3: Various packaging materials used in freezing and canning industry – Polyolefin, wax duplex carton, master carton, can, lacquered can

**Unit 8: Marketing and Finance** **Lectures 15**

8.1: Traditional marketing vis-a-vis role of fishery co-operatives with reference to operations at Satpati, Sasoon Dock and Karanja
8.2: Global marketing and Export-Import procedures
8.3: Fund raising – Financial institutions, schemes and subsidies, basic accounting, costing and feasibility report

## Semester V – Practical (SIUSACFBIOP51)

## Practical based on SIUSACFBIO51

1. Introduction to Oceanographic Instruments – Nansen Reversing Bottle with Thermometer, Peterson's Grab, Dredge

2. Layout of fishing vessels and Sectional view of 2 stroke and 4 stroke marine engines, life saving equipments, winch and deck side equipments

3. Identification of various stages of development of carps and study of sexual dimorphism in adults (Major Carps – *Labeo rohita, Catla catla, Cirrhina mrigala,* Common Carp - *Cyprinus carpio*)

4. Identification of penaeid and non-penaeid prawn

5. Identification of Air Breathing Fishes – *Anabas testudineus, Clarias batrachus, Boleophthalmus spp.*

6. Identification of:
a) Ornamental fishes – Angel, Sword Tail, Neon tetra, Siamese fighter, *Danio*, Discus and Flower Horn
b) Aquatic plants – *Ludwigia, Cobamba,* Cork Screw *Vallisneria*, Aquarose, Amazon Sword plant
c) Aquarium accessories – Aerator, Bottom Filter, Column Filter, Surface Filter, Food dispensers

7. Identification of phytoplanktons and zooplanktons

8. Embedding beads in suitable mollusc (Such as *Unio sp; Katelysia sp.)* under sterilized conditions for pearl culture

9. Microbial Studies –
i) Dilution of Sample
ii) Gram Staining Technique
iii) Identification of Bacilli, Cocci, Vibrio bacteria and Organoleptic tests for fish and prawn

10. Study of gut content of aquatic organisms.

11. Identification of packaging materials –
Waxed duplex carton, Master carton, Simple cans, Coated [Lacquered] cans, Polyolefin

12. Group Activities – Field Visits and Entrepreneurial Skill Development

[**Please refer the Annexures for the suggested topics for field visits (Annexure-I), and entrepreneurial skill development (Annexure- II) for SIUSACFBIOP51]**

**Semester VI – Theory**

**Paper code: SIUSACFBIO61**
**Marine resources, Post-harvest and Farm engineering**
(Any four units to be opted)

***Learning Objectives***

- *To do a detailed study of the marine fin fish of India pertaining to coastal and deep sea fisheries.*
- *To study the crustacean wealth of India and to know its market demand.*
- *To study the nutritional aspects in fishery.*
- *To study the diseases in fish and the various preventive measures and treatments undertaken to improve health of the fish.*
- *To learn about the various preservation and processing techniques employed in fish industry.*
- *To appreciate a vast array of products of commercial importance obtained from fish that are surplus or trash fish and waste from the fishery industry.*
- *To learn about farm engineering to set up aqua farms and to have an idea about the equipments and accessories required in aqua farms.*
- *To know about the various aquaculture practices employed for culturing fish and other aquatic organisms.*

**Unit 1: Marine Fin Fish of India** **Lectures 15**

1.1: Coastal fisheries (up to 45 fathoms) – *Stromateus sinensis, Stromateus cinereus, Stromateus niger, Polynemus tetradactylus, Psuedosciaena diacanthus, Trichiurus haumela, Synagris japonicus, Scomber microlepeidotus, Cybium guttatum, Sardinella longiceps*
1.2: Deep sea fisheries (more than 45 fathoms) of Indian Exclusive Economic Zone – *Thunnus albacore, Sarda orientalis, Rhincodon typus*
1.3: Commercial potential and major landing centres of the above fishes

**Unit 2: Marine Shell Fish of India** **Lectures 15**

2.1: Crustacean fisheries – *Penaeus monodon***;** *Metapenaeus affinis, Parapenaeopsis stylifera, Acetes indicus, Panulirus polyphagus, Scylla serrata*
2.2: Molluscan fisheries – *Pinctada vulgaris, Sepia pharaonis, Loligo duvauceli*
2.3: Commercial potential and major landing centres of the above shell fishes

**Unit 3: Nutrition** **Lectures 15**

3.1: Nutritional requirements at various stages of development of fish and crustaceans
3.2: Culture of natural feed – *Daphnia*, *Chaetoceros* and *Artemia*
3.3: Formulated / Pelleted feeds

**Unit 4: Diseases** **Lectures 15**

4.1: Bacterial, Fungal, Protozoan infections and their treatment
4.2: Worm and crustacean infections and their treatment
4.3: Physiological disorders/ diseases and their treatment

**Unit 5: Preservation and Processing** **Lectures 15**

5.1: Traditional methods of icing, drying, salting and their modifications
5.2: Introduction to refrigeration:
5.2.1: Types and properties of refrigerants, types of freezers –Brine, air blast, tunnel, contact plate and cryo-quick
5.2.2: Freezing procedures including hygienic washing, dressing, PUD (Peeled and Undeveined), DV (Deveined), packaging and freezing for fishes, prawns and their products
5.3: Principle and steps involved in can reform and canning of fish and prawns in various media

**Unit 6: By-products and Value Added Products** **Lectures 15**

6.1: Proximate composition of fish meat and products
6.2: Introduction to by-products – Fish protein concentrate, Fish maws/ Isinglass, Fish hydrolysates, Chitin, Chitosan, Glucosamine hydrochloride, Gelatin, Fish silage, Surimi and Imitation products
6.3: Value addition – Different types of value added products from fish and shell fish – Fish / Prawn pickle, Fish wafers, Prawn (*Acetes indicus*) chutney, Fish soup powder, Fish / Crab steaks

**Unit 7: Farm Engineering** **Lectures 15**

7.1: Site selection and construction of hatchery and farms for Extensive, Semi-intensive and Intensive fresh water fishes
7.2: Site selection and construction of hatchery and farms for Extensive, Semi-intensive and Intensive brackish water fishes
7.3: Equipments and Accessories used in various aqua farms

**Unit 8: Introduction to other Aquaculture Practices** **Lectures 15**

8.1: Raft culture, Rope culture
8.2: Pen culture, Cage culture
8.3: Sports fishery, Sewage fed culture

## Semester VI – Practical (SIUSACFBIOP61)

## Practical based on SIUSACFBIO61

1. Identification of marine fishes –
*Stromateus sinensis, Stromateus cinereus, Stromateus niger, Polynemus tetradactylus, Pseudosciaena diacanthus, Trichiurus haumela, Synagris japonicus, Scomber microlepeidotus, Cybium guttatum, Sardinella longiceps, Thunnus albacore, Rhincodon typhus, Sarda orientalis*

2. Identification of Crustaceans and Molluscs –
*Penaeus monodon, Metapenaeus affinis, Parapenaeopsis stylifera, Acetes indicus, Panulirus polyphagus, Scylla serrata, Pinctada vulgaris, Sepia pharaonis, Loligo duvauceli*

3. Estimation of fish fecundity

4. Estimation of fat/lipid from fish by Folch's Method and proteins by Lowry's Method

5. Preparation of formulated feed for fish and prawn

6. Identification of parasitic infections in aquatic organisms –
Fungal – Dermatomycosis; Bacterial – Fin/ Tail rot and Dropsy; Protozoan – Costiasis and White Spot disease; Worm – Leech; Crustacean – Argulosis

7. Fish dressing, filleting, prawn peeling – PUD, DV and grading

8. Preparation of surimi, fish protein concentrate, fish soup powder

9. Preparations of fish burger, fish fingers, fish/ prawn pickle

10. Preparation of chitosan, isinglass

11. Identification of various farm equipments such as feeding cups, trays, paddle wheels, aerators, fountains, Sluice gate models, elbow pipe outlets

12. Study of models of raft, pen, cage culture and materials used in rope culture

13. Project (individual activity) and assignment (group activity)

**[Please refer the Annexures for the suggested topics for Projects (Annexure-III) and Assignments (Annexure- IV) for SIUSACFBIOP61]**

**REFERENCES**


- The Oceans by Svedrup H.V. – et.al. - Asian Pub. House
- Introductory Oceanography by Harold Thurman – Printis Hall Pub. London – 8th Edition
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- Hand Book of Fresh Water Fishes of India By Beaven C.R. – Narendra Pub. House
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- Fishery Science by Samtharam R. – Daya Pub. House – 1990
- Aquaculture, Principles and Practices by Pillay T.V.R. – Fishing New Books (1988)
- Fisheries Biology, Assessment and Management By Michael King – Fishing News Publishers (1995)
- Handbook of Fish Biology and Fisheries Edited By J.B. Hart & John Reynold
- Course Manual in Fishing Technology by Latha Shenoy, CIFE, Versova, Mumbai
- An Introduction to Fishes by Khanna S.S. – Central Book Depot, Allahabad (1993)
- Text Book of Fish Biology and Indian Fisheries by Dr. R. P. Parihar, Central Pub. House, Allahabad
- Financial management by Prasanna Chandra- Seventh Edition
- Financial management by Khan & Jain
- Financial management by I. M. Pandey
- Project Management by Prasanna Chandra
- Marketing Management by Philip Kotler
- For Additional and Latest Information on the topics, various websites can be visited

## Semester V – SIUSACFBIOP51

## Annexure – I
## Suggested Field Visits (Group activity)

Field visits are to be organised to facilitate students to have firsthand experience and exposure to technology/ production / functioning of an organisation / unit or witness a relevant activity. Each student must make at least 1 such visit to the units/ markets/ sea shores out of 2 to 3 such visits organized by the college.

I) Visit to one of the units with one or multiple activities such as:
Ornamental / Brackish water / Fresh water fish farm / hatchery

II) Visit to witness one of the activities such as:
Fish angling / trawling / purse seining / gill netting
Fish finding operations, etc. (Echo Sounder/Sonar/Fish Magnifier).

III) Visit any production units such as:
Food / Fish processing and preservation
Ornamental articles

IV) Hi-tech and multinational total export oriented units such as:
IQF plant
Surimi plant
Fishery plant
Microbiological units
Hi–tech fish / prawn / chick hatcheries
Fish consumer product industries

V) Others :
Self Sale Groups
Co-operative Societies

VI) Government Offices such as:
Fishery Department
MPEDA
Wild-life Authority
CITES
JDEI (Jt. Director-Export & Import)
Sales Tax
Income Tax
Excise Department
Customs Authority of India
Local Self Government (BMC)
Clearing Agencies /Agents
FDA
ISI
Ag Mark, etc.

VII) Visit any ancillary unit such as:
Ice plant
Can reforming
Packaging
Cold storage

VIII) Visit to National Laboratories, National Research Labs and Training Institutes such as:
NIO, CIFE, CMFRI, CIFT, FSI, IFP, CIFI, CIFNET, NBFGR, etc.

## Semester V – SIUSACFBIOP51

### Annexure – II
### Suggested Topics for Entrepreneurial Skill Development (Group activity)

1. Curing and drying of Jew fish (Dhoma), Ribbon fish, Bombay duck
2. Preparation/ Collection of different fibres and their specifications
3. Preparation of aquarium fish feed
4. Setting and maintenance of fresh water aquarium
5. Setting and maintenance of marine aquarium
6. Breeding of various aquarium fishes
7. Collection of various types of Hooks used in fishing
8. Maintenance of *Daphnia* culture and Tubifex worms, Rotifer culture, *Artemia* culture
9. Study of shelf life of desired products such as prawn pickle, fish wafers, fish burger
10. Breeding of Prawns
11. Breeding of aquarium fishes
12. Rearing of aquarium fishes
13. Propagation of aquatic plants

## Semester VI – SIUSACFBIOP61

### Annexure – III
### Suggested Topics for Individual Project

1. Feasibility report of the maintenance of aquarium fishes in high profile residences.
2. Feasibility report of fresh water /brackish water fish /prawn culture for extensive, semi intensive and intensive systems.
3. Probability report of maintenance of a culture of *Chaetoceros* and *Artemia* by the fish farmers.
4. Project report for the establishment of small /medium /large scale ice factory, freezing and canning industry.
5. Feasibility report of various packaging materials in freezing /canning industry.
6. Feasibility report for establishing an aquarium shop.
7. Feasibility report for establishing a fish feed industry.
8. Monitoring various physico-chemical parameters of an aquarium /pond /lake /river /sea.

## Semester VI – SIUSACFBIOP61

### Annexure – IV
### Suggested Topics for Group Assignments

1. Study of market survey for various preserved and processed fish /prawn.
2. Handling of fish on board, at landing centre, in secondary market and at consumer level.
3. Preparation of by-products from fishes /crustaceans /molluscs and their costing /production cost.
4. Survey of fish markets for fluctuation in the availability and price of fishes.
5. Survey of the local market for the availability of various by-products, value added products and their price.
6. Study of economics of brackish water pond culture.
7. Study of working of fisheries co-operative societies.
8. Study of cost of construction of fishing vessel and subsidies available for the same.
9. Study of cost of gear manufacturing with different materials and subsidies available for the same.
10. Study of cost and profit analysis of any one of the following methods - Trawler, Gill netter, Purse seiner, Hooks and lines and Non-mechanised fishing units.
11. Survey of various packaging materials used in fish processing industries.
12. Survey of various feeds used in local aqua farms.
13. Study of economics of pond culture from nearby area.
14. Comparative cost analysis of fingerlings of major carps from your area.
15. Setting up of marine aquarium with various accessories and its costing.
16. Construction of aquaria of different sizes and shapes.
17. Study of various courses run by Institutes in your area in relation to fisheries.

**Practical Examination Question Paper Pattern**
**Semester V – Practical (SIUSACFBIOP51)**

**Practical based on SIUSACFBIO51**

**Time: 5 hours** **Marks: 100**

**Q.1** Perform organoleptic tests to differentiate fresh and stale fish and prawn. **20**

**Q.2** Prepare various dilutions of the given sample of bacteria. **16**

**OR**

**Q.2** Identify the given bacteria with the help of Gram's staining technique. **16**

**Q.3** Identification **30**
a) Identify and describe the oceanographic instrument
b) Identify and label the diagram/ identify and describe 2 stroke/ 4 stroke engine
c) Identify and describe the life saving equipment / deck side equipment
d) Identify the fish and explain the accessory respiratory organ
e) Identify and describe the ornamental fish/ aquarium plant/ aquarium accessory
f) Identify and describe packaging material

**Q.4**
a) Field visit - Report and viva voce **07**
b) Entrepreneurial skill development - Report and viva voce **07**

**Q.5** Viva based on practical **10**

**Q.6** Journal **10**

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**Practical Examination Question Paper Pattern**
**Semester VI – Practical (SIUSACFBIOP61)**

**Practical based on SIUSACFBIO61**

**Time: 5 hours** **Marks: 100**

**Q.1** Identification **30**
a) Identify and describe the given fish w.r.t. fishery
b) Identify and describe the given fish w.r.t. fishery
c) Identify and describe the given crustacean/ mollusc w.r.t. fishery
d) Identify and describe the pathogenicity and prevention and treatment for the given specimen
e) Identify and describe the farm equipment/ model/ material

**Q.2** Estimate the fecundity of the given fish. **20**

OR

**Q.2** Estimate the fat/ lipid from the given fish muscle. **20**

OR

**Q.2** Estimate the protein from the given fish muscles by Lowry's method. **20**

OR

**Q.2** Demonstrate the technique of fish dressing and filleting. **20**

OR

**Q.2** Prepare the marked by-product with suitable method: **20**
Surimi/ fish protein concentrate/ fish soup powder/ fish burger/ fish or prawn pickle

**Q.3** Project **20**

**Q.4** Field visit - Report and viva **10**

**Q.5** Viva based on practical **10**

**Q.6** Journal **10**

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**T. Y. B. Sc. Fishery Biology (Applied Component) Syllabus (Autonomous)**
**Credit Based Semester and Grading System**
**(With effect from academic year 2018-19)**

## Scheme of Examination

The performance of learners will be evaluated in two parts for the Theory component of the Course:
1. Internal Assessment with 40% marks
2. Semester End Examination (written) with 60% marks
The Practical component of the Course will be evaluated by conducting Semester End Practical Examination of 50 marks.

### Internal Assessment Theory (40%)

It is the assessment of learners on the basis ofcontinuous evaluation as envisaged in the Credit Based System by way of participation of learners in various academic and correlated activities in the given semester of the program.

**Marks: 40**
1. Class test (Centralized Examination): **20 Marks**
2. At the departmental level evaluation will be conducted on the basis of assignment/ case study report/ project submitted by the student: **20 Marks**

### Semester End Assessment Theory (60%)

**Marks: 60**
**Duration: 2 hours**
**Theory question paper pattern:**

- There shall be five questions of 12 marks each. On each unit there will be one question and the $5^{th}$ question will be based on the entire syllabus.
  **OR**
  There shall be four questions of 15 marks each, each question based on one unit.
- All questions are compulsory with internal choice within the questions.
- Questions may be subdivided and the allocation of marks depends on the weightage of the topic.

### Semester End Assessment Practical

**Marks: 100**
**Duration: 5 hours**

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