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# S.Y.B. Tech. (Mechanical) (Semester-III) (CBCS)
## Examination, November - 2019
## ELECTRICAL TECHNOLOGY
### Sub. Code : 73204

**Day and Date : Tuesday, 26 - 11 - 2019** **Total Marks : 70**

**Time : 10.00 a.m. to 12.30 p.m.**

**Instructions :**
1) **Attempt any 3 questions from each Section.**
2) **Figures to right indicate full marks.**
3) **Draw neat labeled diagrams whenever necessary.**
4) **In case of missing data, assume suitable value. State it clearly.**

## SECTION-I

**Q1)** a) Explain speed control methods for DC shunt motor. **[6]**

b) A 250V dc series motor runs at 1200 rpm taking 35A Current. If the flux is reduced by connecting a 0.6 ohm field diverter, find the new speed. The load requires constant torque at all speeds. Ra=1 ohm, Rf=0.6 ohm. **[6]**

**Q2)** a) The input power to a 4 pole, 50 Hz 3 phase induction motor is 5kW and running with a speed of 1400rpm. Stator losses 250W, frictional losses 100W, Find **[6]**

i) Rotor copper losses

ii) Efficiency of motor

iii) Shaft Torque

b) State & Explain working principle of 3 phase Induction Motor. **[5]**

**Q3)** a) State and explain Rotor Resistance speed control method for 3 phase I.M. **[6]**

b) With a neat diagram explain the working of Auto transformer starter. **[5]**

*P.T.O.*

**Q4)** Answer any Two **[2×6=12]**

a) Explain the concept of Reversal rotation of DC motor.

b) Derive running torque equation for 3 phase Induction Motor.

c) State and explain speed control methods for 3 phase Induction Motor from stator side.

## SECTION-II

**Q5)** a) Explain construction and working principle of AC Servomotor. **[6]**

b) Draw & explain construction, working of VR type Stepper Motor. **[6]**

**Q6)** a) Explain 4 quadrant operation of DC motor. **[6]**

b) Suggest a motor for the following applications **[5]**

i) Lift ii) Pump

iii) Traction iv) Lathe

v) Conveyors

**Q7)** a) Determine the amount of energy and input power required to melt 1000kg of brass in a single-phase core type furnace. If the melt is to be carried out in 1 hour with furnace efficiency of 70%.
Specific heat of brass = 393.6J/kg °C, Latent heat = $163 \times 10^3$ J/kg, melting point of brass = 920 °C, initial temperature = 20 °C. **[6]**

b) Explain construction and working of Indirect Resistance heating. **[5]**

**Q8)** Answer any two **[2×6=12]**

a) Draw & explain Permanent Capacitor type Induction Motor.

b) Compare Group drive & Individual drive.

c) Explain construction and working of Horizontal Core type induction furnace.

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# S.E. (Mechanical) (Semester - III) (Revised) Examination, November - 2019

## ELECTRICAL TECHNOLOGY

## Sub. Code : 63351

**Day and Date : Tuesday, 26 - 11 - 2019** **Total Marks : 100**

**Time : 10.00 a.m. to 1.00 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figures to right indicate full marks.**
3) **Draw neat labeled diagrams whenever necessary.**
4) **In case of missing data, assume suitable value. State it clearly.**

## SECTION - I

**Q1)** a) Explain construction and working of DC Motor with a neat diagram. **[1×8]**

OR

Explain speed control methods for DC shunt motor.

Answer any two out of following sub questions b,c,d. **[2×6]**

b) Derive torque equation of DC motor.

c) Explain the concept of Back EMF for DC motor and state its importance.

d) A 500 V shunt motor runs at 1000 rpm, when armature current is 200 A. The resistance of armature is 0.12 Ω. Calculate speed when a resistance is inserted in the field to reduce the field of 70% of normal value & armature current is 100 A. The load requires constant torque at all speeds.

**Q2)** Answer any two. **[2×8]**

a) State & explain working principle of 3 phase Induction Motor. State the advantages of three phase induction motor.

b) Draw & explain Torque-Speed characteristics of 3 phase I.M. Explain the importance of stable operating region of T-N characteristics of 3 phase induction motor.

*P.T.O.*

c) The input power to a 500V, 50Hz, 6 pole, 3 phase induction motor running at 950 rpm is 25kW. The stator losses are 2kW and mechanical losses 3kW. Calculate

i) Slip ii) Rotor copper losses

iii) Shaft Power iv) Efficiency

**Q3)** Answer any two. **[2×8]**

a) Draw & explain Reversal of rotation of 3 phase I.M.

b) Draw the block diagram and explain VFD control to control speed of 3 phase I.M.

c) Why does induction motor takes large current at starting? How to reduce it from Star Delta starter.

## SECTION - II

**Q4)** Answer any two. **[2×8]**

a) State the types of Servomotor. Explain construction, working and applications of AC servomotor.

b) Explain construction and working principle of PM type Stepper motor. State its applications.

c) Why BLDC motor is called as BLDC? Explain working principle and its applications.

**Q5)** Answer any two. **[2×8]**

a) Classify mechanical loads on the basis of torque speed variation. State two examples each.

b) Explain 4 quadrant operation of electric motor. Comment on power flow in each quadrant.

c) State and explain various factors to be considered to select a motor for a particular drive.

**Q6)** Answer any two. **[2×8]**

a) Explain the construction and working of coreless induction furnace.

b) Explain the construction and working of indirect resistance heating furnace.

c) Find the energy and power input required to melt 5 metric ton of steel in an 3 hour at an overall efficiency of 50%. of the furnace. If initial temperature is 30°C, melting point of steel is 1370°C, specific heat of steel is 278 J/kg/°C, and latent heat of steel is 37000 J/kg.

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# S.E. (Mechanical) (Part - II) (Semester - IV) (Revised) Examination, November - 2019

## MACHINE TOOLS & PROCESSES

### Sub. Code : 63364

**Day and Date : Wednesday, 20 - 11 - 2019** **Total Marks : 100**

**Time : 2.30 p.m. to 5.30 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Assume suitable data, if necessary.**
4) **Use of non-programmable scientifice calculator is allowed.**

**Q1)** Attempt any two

a) Describe in brief different types of sand used to prepare mold in sand casting process. State the desirable properties of molding sand. **[8]**

b) Explain with neat sketch centrifugal casting process. State the application of Centrifugal casting. **[8]**

c) State types of induction furnaces used in foundry for melting of CI. Explain in brief working of any of induction furnace with neat sketch. **[8]**

**Q2)** Attempt any two

a) Define rolling process. Explain with neat sketch tandem rolling mill. **[8]**

b) Explain the following with neat sketch **[8]**

i) Operations performed in forging.

ii) Tube drawing process

c) Describe with neat sketch indirect extrusion process. State the applications of direct & indirect extrusion process. **[8]**

**Q3)** Write a short note on Any Three

a) Applications and advantages of Injection molding & Blow molding **[6]**

b) Thermoforming process **[6]**

c) Defects in forging **[6]**

d) Casting defects **[6]**

*P.T.O.*

**Q4)** Attempt any two

a) Describe thread cutting mechanism on lathe? [4]

If a lathe is provided with a change gear set from 20 to 125 teeth in steps of 5 teeth and an additional gear of 127 teeth. Find the gear train for cutting metric thread of 6.25 mm pitch on a lathe having lead screw pitch as 6 TPI. [4]

b) What is the purpose of bar feeding mechanism? Explain with neat sketch working of the same. [8]

c) Explain with neat sketch construction & working of radial drilling machine. [8]

**Q5)** Attempt any two

a) Name the different types of milling cutters used. State its applications. Also draw neat sketch of the milling cutters. [8]

b) How does crank & slotted link quick return mechanism work in shaper? State various operations performed on shaper. [8]

c) State gear manufacturing processes. Explain with neat sketch gear shaping process. [8]

**Q6)** Write a short note on Any Three

a) Jig Boring Machine. [6]

b) Process parameters of Abrasive Jet Machining and its limitations. [6]

c) Set up of Electro- Chemical machining and its applications. [6]

d) Process parameters of Ultrasonic machining and its advantages. [6]

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# S.E. (Mechanical) (Part-II) (Semester - IV)

## Examination, November - 2019

## THEORY OF MACHINES-I

## Sub. Code : 63363

**Day and Date : Tuesday, 19- 11 - 2019** **Total Marks : 100**

**Time : 2.30 p.m to 5.30 p.m.**

**Instructions :**

1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Draw neat labeled sketches wherever necessary.**
4) **Assume if necessary suitable data & state clearely.**
5) **Use of Non-programmable calculator is permissed.**

**Q1)** a) What is inversion of mechanism? Explain inversions of double slider crank chain with neat sketches. **[8]**

OR

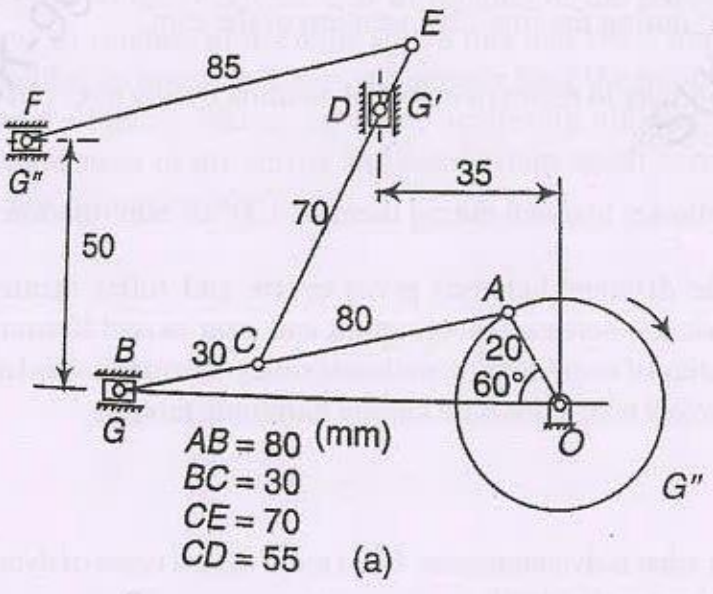
Explain condition of correct steering. Also differentiate Ackerman steering gear mechanism and Davis Steering gear mechanism. **[8]**

b) In a slider crank mechanism, the lengths of the crank and connecting rod are 200 mm and 800 mm respectively. Locate all I-centers of the mechanism for the position of the crank when it has turned 30° from the inner dead center. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/s. **[8]**

**Q2)** In the mechanism shown in following figure, the crank OA rotates at 210 rpm clockwise. For the given configuration, determine the velocities and accelerations of sliders B,D and F. The various link lengths are,

***P.T.O.***

AB=80 mm, BC=30 mm, CD=55 mm and CE= 70 mm, OA= 20 mm, EF=85 mm. **[18]**




**Q3)** a) Derive the equation for force required to lift the load in square threaded screw jack using inclined plane theory. **[8]**

OR

a) Derive the equation for torque required to overcome the friction in collar pivot bearing using uniform wear theory. **[8]**

b) A 150 mm diameter valve, against which a steam pressure of 2 MN/m2 is acting, is closed by means of a square threaded screw 50 mm in external diameter with6 mm pitch. If the coefficient of friction is 0.12; find torque required to turn the handle. **[8]**

**Q4)** a) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion and uniform acceleration and retardation. **[6]**

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# S.E. (Mech.) (Semester - IV) Examination, November - 2019
## APPLIED NUMERICAL METHODS
### Sub. Code : 63360

**Day and Date : Wednesday, 13 - 11 - 2019** **Total Marks : 100**

**Time : 2.30 p.m. to 5.30 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Use of non programmable calculator is allowed.**
3) **Assume additional data if required and mention it clearly.**

**Q1)** Solve any two: **[16]**

a) Perform two iterations of Newton Raphson Method to Solve:

$x^2 + xy + y^2 = 7, x^3 + y^3 = 9$

Take initial approximations $X_0 = 1.5, Y_0 = 0.5$.

b) Define errors? Explain Approximation error with an example.

c) Find root of equation $x^3 - 4x - 9 = 0$ using bisection method, correct to three decimal places.

**Q2)** Solve any two: **[16]**

a) Solve following equations by Gauss Seidal method.

$2x + y + 6z = 9, 8x + 3y + 2z = 13, x + 5y + z = 7.$

b) Solve following equations using LU-decomposition method

$10x + y + 2z = 13, 3x + 10y + z = 14, 2x + 3y + 10z = 15.$

c) Solve by Jacobi Iteration Method

$8x - 3y + 2z = 20, 6x + 3y + 12z = 35, 4x + 11 - z = 33$

*P.T.O.*

**Q3)** Solve any three: **[18]**

a) What are the applications of binomial distribution and normal distribution.

b) Find Mean and Median

| Marks | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|---|---|---|---|---|---|---|
| No. of Students | 12 | 18 | 27 | 20 | 17 | 6 |

c) Find missing term in the following table using Lagrange's interpolation formula.

| X | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Y | 1 | 3 | ? | 31 | 81 |

d) Find f(x) as a polynomial in x and f(6) for the following data by Newton's divided difference formula

| $x$ | 1 | 2 | 7 | 8 |
|---|---|---|---|---|
| $f(x)$ | 1 | 5 | 5 | 4 |

**Q4)** Solve any three: **[3×6=18]**

a) Evaluate the integral $I = \int_0^{\pi} \sin x \, dx$ using Trapezoidal and Simpsons 1/3rd Rule.

Take $n = 10$.

b) Use Romberg's method to evaluate $\int_0^1 \frac{x}{\sin x} dx$ take h = 0.5, 0.25, and 0.125.

c) Evaluate $\int_0^{\pi/2} (\sin x) dx$ by two point Gaussian Quadrature formula.

d) Find the value of cos(1.74) from the following table

| $x$: | 1.7 | 1.74 | 1.78 | 1.82 | 1.86 |
|---|---|---|---|---|---|
| Sin($x$): | 0.9916 | 0.9857 | 0.9781 | 0.9691 | 0.9584 |

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# S.Y. B.Tech. (Mechanical Engg.) (Semester - III) (CBCS) Examination, November - 2019

## ENGINEERING MATHEMATICS - III

### Sub. Code : 73203

**Day and Date : Saturday, 23 - 11 - 2019** **Total Marks : 70**

**Time : 10.00 a.m. to 12.30 p.m.**

**Instructions :**
1) Attempt any three questions from each section.
2) Figures to the right indicate full marks.
3) Use of non-programmable calculator is allowed.
4) Assume suitable data if necessary.

## SECTION - I

**Q1)** Solve the following.

a) Solve $\left(D^2+2\right)y=x^2e^{3x}$ **[6]**

b) Solve $\left(D^3+1\right)y=\cos^2\left(\frac{x}{2}\right)+e^{-x}$ **[6]**

**Q2)** Solve the following.

a) Fit a second degree curve to the following data **[6]**

| x | 3 | 2 | 1 | 0 | −1 | −2 | −3 |
|---|---|---|---|---|---|---|---|
| y | 10 | 8 | 3 | 1 | 2 | 6 | 8 |

b) Fit a curve of the form $y=ab^x$ to the following data **[5]**

| x | 2 | 3 | 4 | 5 | 6 |
|---|---|---|---|---|---|
| y | 34.385 | 79.0856 | 181.90 | 418.36 | 962.23 |

**Q3)** Solve the following.

a) Find the Laplace transform of $f(t)=\begin{cases}1, & 0\le t<1\\ t, & 1\le t<2\\ t^2, & 2\le t<\infty\end{cases}$ **[5]**

b) Find inverse Laplace transform of $\frac{s+4}{s(s-1)\left(s^2+4\right)}$ **[6]**

*P.T.O.*

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Total No. of Pages : 3

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# S.E. (Mechanical Engg.) (Semester - III) (Revised) Examination, November - 2019

## ENGINEERING MATHEMATICS - III

### Sub. Code : 63350

**Day and Date : Saturday, 23- 11 - 2019** **Total Marks : 100**

**Time : 10.00 a.m. to 1.00 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figure to the right indicates full marks.**
3) **Use of non-programmable calculator is allowed.**
4) **Assume suitable data if necessary.**

## SECTION - I

**Q1)** Attempt Any Three of the following.

a) Solve $(D^2 - 6D + 9)\, y = 6e^{3x} + 7e^{-2x} - \log 2$. **[6]**

b) Solve $(D^3 - D^2 - 6D)\, y = x^2 + 1$. **[6]**

c) Solve $(D^2 + a^2)\, y = \sec ax$. **[6]**

d) Solve $x^2 \frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = e^x$. **[6]**

**Q2)** Attempt Any One of the following:

a) The differential equation for the displacement y of a whirling shaft when the weight of the shaft is taken into account is $EI\frac{d^4y}{dx^4} - \frac{W\omega^2}{g}y = W$.

Taking the shaft of length $2l$ with the origin at the centre and short bearings at both ends, show that the maximum deflection of the shaft is

$\frac{g}{2\omega^2}[\text{sech } al + \sec al - 2]$. **[16]**

b) A body weighing 10 kg is hung from a spring. A pull of 20 kg weight will stretch the spring to 10 cm. The body is pulled down to 20 cm below the static equilibrium position and then released. Find the deflection of the body from its equilibrium position at time $t$ second, the maximum velocity and the period of oscillation. **[16]**

*P.T.O.*

**Q3)** Attempt Any Four of the following.

a) Find the directional derivative of $\phi = xy^2 + yz^2$ at point P(2, –1, 1) in the direction of the vector $\vec{i} + 2\vec{j} + 2\vec{k}$. **[4]**

b) Find unit vector normal to the surface $2x^2 + 4yz - 5z^2 = -10$ at (3, –1, 2). **[4]**

c) Find the value of n for which the vector $r^n\vec{r}$ is solenoidal, where $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$. **[4]**

d) If $\vec{a} = a_1\vec{i} + a_2\vec{j} + a_3\vec{k}$ is constant vector and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$, prove that $\nabla.\left[\frac{\vec{a}\times\vec{r}}{r^n}\right] = 0$. **[4]**

e) If $\phi = x^2 + y^2 + z^2$ prove that the curl $(\nabla\phi) = 0$. **[4]**

## SECTION - II

**Q4)** Attempt any Three from the following.

a) Find **[6]**

i) $L\{f(t)\}$, where $f(t) = \begin{cases} 4, & 0 \le t \le 1 \\ 3, & t > 1 \end{cases}$ and

ii) $L^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\}$

b) Find $L\left\{t\int_0^t \frac{e^{-t}\sin t}{t}dt\right\}$. **[6]**

c) Find inverse Laplace transform of $\frac{s}{(s-3)(s^2+4)}$. **[6]**

d) Find $L^{-1}\left\{\log\left(\frac{s+1}{s-1}\right)\right\}$. **[6]**

e) Using Laplace transform method, solve $y''(t) + y(t) = t$ given that $y(0) = 1$ and $y'(0) = 0$. **[6]**





**Q5)** Attempt any Two from the following.

a) Obtain Fourier series expansion of the function

$$f(x) = \begin{cases} \pi x, & 0 \le x \le 1 \\ \pi(2-x), & 1 \le x \le 2 \end{cases}$$ **[8]**

b) Find the fourier series expansion for $f(x) = x + \frac{x^2}{4}, -\pi \le x \le \pi$ and hence show that $\frac{\pi^2}{12} = 1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots$ **[8]**

c) Expand $f(x) = e^x$ in a cosine series and sine series over (0, 1). **[8]**

**Q6)** Attempt any One from the following. **[16]**

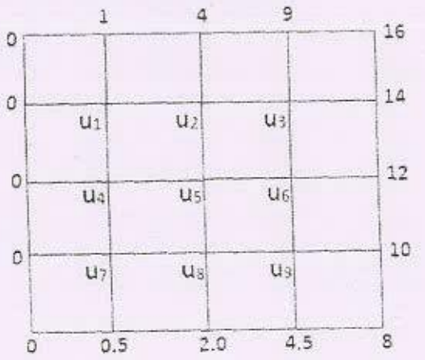
a) Solve the differential equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the following conditions:

i) $u$ is finite for all $t$

ii) $u = 0$ for $x = 0$ and $x = \pi$ for all $t$

iii) $u = \pi x - x^2$ for $t = 0$ between $x = 0$ and $x = \pi$.

b) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in figure by Gauss-Siedal iterative method by performing three iterations.



)6) a) Give different methods to improve the efficiency and specific output of simple gas turbine cycle. Explain any one with neat sketch. [8]

b) Following particular relates to closed cycle gas turbine using air as working medium.

Atmospheric temperature = 26°C

Maximum temperature = 870°C

Initial pressure in compressor = 1bar

Final pressure of compressor = 5 bar

Turbine efficiency = 0.84

Compressor efficiency = 0.8

Calorific value of fuel = 41840 KJ/kg

Cp = 1.005 kJ/Kg K

$\gamma = 1.4$

Determine the compressor work, turbine work, net work done and thermal efficiency of gas turbine. [8]

OR

c) A simple gas turbine takes air in at atmospheric pressure at 15°C and compresses the air in the compressor up to 6 bar. Then air enters the combustion chamber and is heated to maximum temperature of 750°C. Then it enters the turbine and expands to atmospheric pressure if isentropic efficiency of compressor and turbine is 0.8, Cp for both air and gases 1.005 kJ/kgK, $\gamma = 1.4$. Determine mass flow rate of air and gases through turbine to develop net power of 1100 kW. [8]

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**S.E. (Mechanical Engineering) (Part - II) (Semester - IV) (Revised) Examination, November - 2019**

**FLUID AND TURBO MACHINERY**

**Sub. Code : 63362**

**)ay and Date : Friday, 15 - 11 - 2019** **Total Marks : 100**

**Time : 2.30 p.m. to 5.30 p.m.**

**nstructions :**
1) **All questions are compulsory.**
2) **Figures to the right side indicate full marks.**
3) **Assume suitable data if necessary and indicate clearly.**
4) **Use of non programmable calculator is allowed.**

)1) a) Explain governing of peltonturbine with neat sketch. [8]

b) A pelton wheel has a mean bucket speed of 12 m/s and is supplied water at a rate of 750 litres per second under a head of 35m. If the bucket deflects the jet through angle of 160°, find the power developed by the turbine and its hydraulic efficiency. Take the coefficient of velocity as 0.98. Neglect friction in the bucket. Also determine the overall efficiency of the turbine if the mechanical efficiency is 80%. [8]

OR

c) A pelton wheel working under a head of 500 meters has an overall efficiency of 85% and runs at 430 rpm developing 6990 KW of shaft power. Taking the bucket speed at 0.47 times the jet speed and assuming Cv = 0.97, find (i) the wheel diameter & (ii) jet diameter. [8]

)2) a) Explain the construction & working of francis turbine by drawing a neat sketch. [8]

b) A reaction turbine works at 450 rpm under a head of 120 meters. Its diameter at inlet is 1.20m and the flow area is 0.4m$^2$. The angles made by the absolute & relative velocities at inlet are 20° & 60° respectively with the tangential velocity. Determine :

i) Volume flow rate,

ii) Power developed

iii) Hydraulic efficiency

Assume whirl at outlet to be zero. [8]

OR

*P.T.O.*

c) Particulars of a reaction turbine are given below: Head on turbine = 180mm; Inlet diameter = 4.25m; outlet diameter = 2.75m; Inlet vane angle = 120°; velocity of flow at outlet = 16 m/s; Hydraulic efficiency = 92% width of wheel is same at inlet & outlet. Discharge at outlet is entirely radial. Calculate the speed of the turbine. **[8]**

3) a) Draw neat sketch of centrifugal pump & explain different heads associated with it. **[8]**

b) A centrifugal pump discharging 570 litres of water per second has to develop a head of 12 meters, the speed of rotation of impeller being 750 rpm. The manometric efficiency is 80% and loss of head in the pump due to friction is $0.026\ V^2$ meters of water where '$V_1$' is the velocity with which the water leaves the impeller. Assume that the velocity of flow through the impeller is constant at 2.7 meters per second & that there is no velocity of whirl at inlet. Determine : **[10]**

i) Diameter of the impeller;

ii) Outlet area,

iii) Vane angle at the outlet edge of the impeller.

OR

c) A centrifugal pump having an overall efficiency of 75% delivers 1820 litres of water per minute to a height of 18 metres through a pipe of 100 mm diameter and 90 meters length. Taking $f = 0.012$, find power required to drive the pump. **[10]**

4) a) Explain the working of two stage reciprocating compressor with help of P-V diagram and derive equation for work done by compressor. **[8]**

b) Write short note on any two **[10]**

i) Different efficiencies of reciprocating compressor.

ii) Workdone during the Polytropic compression ($PV^n$ = constant) in single stage reciprocating compressor.

iii) Working and Construction of root blower.

OR





c) Solve following two questions **[10]**

i) Single stage single acting reciprocating air compressor has a bore of 200 mm and stroke of 300 mm. It receives air at 1 bar and 20°C and delivers it at 5.5 bars. If the compression follows the law $PV^{1.3}$ = constant and clearance volume is 5 % of stroke volume, determine the power required to drive the compressor if it runs at 500 rpm.

ii) A compressor draws 42.5 $m^3$ of air per minute into the cylinder at a pressure of 1.05 bar. It is compressed polytropically ($PV^{1.3}$ = constant) to a pressure of 4.2 bar before being delivered to receiver. Assuming a mechanical efficiency of 80% find

1) Indicated power

2) Shaft power

3) Overall isothermal efficiency

Q5) a) Explain following terms used in working of axial flow compressor. **[8]**

i) Surging

ii) Choking

iii) Stalling

b) Define degree of reaction of axial flow compressor and comments on following case of degree of reaction **[8]**

i) Low degree of reaction stage

ii) 50% degree of reaction stage

iii) High degree of reaction stage

OR

c) A rotary air compressor receives air at pressure of 1 bar and 17°C and delivers it at a pressure of 6 bar. Determine per kg of air delivered, work done by the compressor and heat exchanged with the jacket water when the compression is isothermal, isentropic and by the relation $PV^{1.6}$ = Constant. **[8]**

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# S.E. (Mechanical) (Semester - IV)
# Examination, November - 2019
# ANALYSIS OF MECHANICAL ELEMENTS
## Sub. Code : 63361

**Day and Date : Thursday, 14 - 11 - 2019** **Total Marks : 100**
**Time : 2.30 p.m. to 5.30 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Assume suitable data wherever necessary and state it clearly.**
3) **Figures to the right indicate full marks.**
4) **Draw neat and labeled sketches wherever necessary**
5) **Use of non programmable calculator is allowed**

**Q1)** a) A steel bar 20 mm in diameter is enclosed in a brass tube of 25 mm external diameter and 2 mm thick. Assuming Es/Eb = 2 and initial length of both the components is 400 mm. calculate stresses in steel and brass of the composite section which is subjected to an axial compressive force of 50 KN. Assume Es = 200 GPa. Find also change in length of composite section. **[12]**

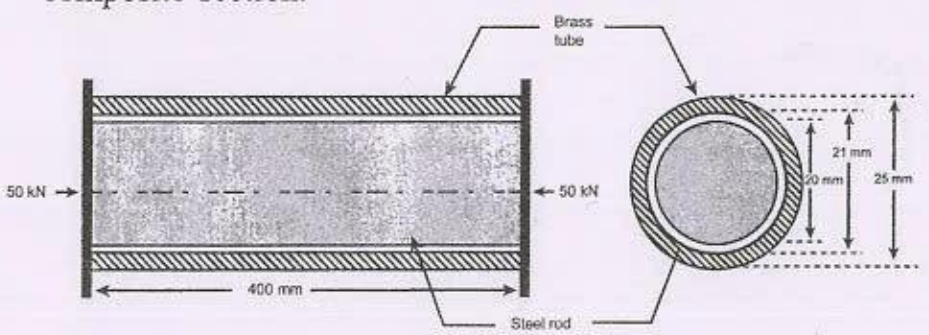


Fig. 1

b) Draw stress-strain diagram of ductile and brittle material subjected to axial loading and explain the important points of diagram **[6]**

OR

A hollow steel shaft is to transmit 300 KW power at 80 rpm. If the shear stress is not to exceed 60 N/mm$^2$ and internal diameter is 0.6 of the external diameter. Find external and internal diameters, assuming that maximum torque is 1.4 times the mean torque. **[6]**

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# S.E. (Mechanical Engg.) (Semester - III) (Revised) Examination, November - 2019

## ENGINEERING MATHEMATICS - III

### Sub. Code : 63350

**Day and Date : Saturday, 23- 11 - 2019** **Total Marks : 100**

**Time : 10.00 a.m. to 1.00 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figure to the right indicates full marks.**
3) **Use of non-programmable calculator is allowed.**
4) **Assume suitable data if necessary.**

## SECTION - I

**Q1)** Attempt Any Three of the following.

a) Solve $(D^2 - 6D + 9)\, y = 6e^{3x} + 7e^{-2x} - \log 2$. **[6]**

b) Solve $(D^3 - D^2 - 6D)\, y = x^2 + 1$. **[6]**

c) Solve $(D^2 + a^2)\, y = \sec ax$. **[6]**

d) Solve $x^2 \frac{d^2y}{dx^2} + 4x\frac{dy}{dx} + 2y = e^x$. **[6]**

**Q2)** Attempt Any One of the following:

a) The differential equation for the displacement y of a whirling shaft when the weight of the shaft is taken into account is $EI\frac{d^4y}{dx^4} - \frac{W\omega^2}{g}y = W$.

Taking the shaft of length $2l$ with the origin at the centre and short bearings at both ends, show that the maximum deflection of the shaft is

$$\frac{g}{2\omega^2}[\sec h\, al + \sec al - 2].$$ **[16]**

b) A body weighing 10 kg is hung from a spring. A pull of 20 kg weight will stretch the spring to 10 cm. The body is pulled down to 20 cm below the static equilibrium position and then released. Find the deflection of the body from its equilibrium position at time $t$ second, the maximum velocity and the period of oscillation. **[16]**

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**Q3)** Attempt Any Four of the following.

a) Find the directional derivative of $\phi = xy^2 + yz^2$ at point P(2, –1, 1) in the direction of the vector $\vec{i} + 2\vec{j} + 2\vec{k}$. **[4]**

b) Find unit vector normal to the surface $2x^2 + 4yz - 5z^2 = -10$ at (3, –1, 2). **[4]**

c) Find the value of n for which the vector $r^n\vec{r}$ is solenoidal, where $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$. **[4]**

d) If $\vec{a} = a_1\vec{i} + a_2\vec{j} + a_3\vec{k}$ is constant vector and $\vec{r} = x\vec{i} + y\vec{j} + z\vec{k}$, prove that $\nabla.\left[\frac{\vec{a}\times\vec{r}}{r^n}\right] = 0$. **[4]**

e) If $\phi = x^2 + y^2 + z^2$ prove that the curl $(\nabla\phi) = 0$. **[4]**

## SECTION - II

**Q4)** Attempt any Three from the following.

a) Find **[6]**

i) $L\{f(t)\}$, where $f(t) = \begin{cases} 4, & 0 \le t \le 1 \\ 3, & t > 1 \end{cases}$ and

ii) $L^{-1}\left\{\frac{3s+7}{s^2-2s-3}\right\}$

b) Find $L\left\{t\int_0^t \frac{e^{-t}\sin t}{t}dt\right\}$. **[6]**

c) Find inverse Laplace transform of $\frac{s}{(s-3)(s^2+4)}$. **[6]**

d) Find $L^{-1}\left\{\log\left(\frac{s+1}{s-1}\right)\right\}$. **[6]**

e) Using Laplace transform method, solve $y''(t) + y(t) = t$ given that $y(0) = 1$ and $y'(0) = 0$. **[6]**





**Q5)** Attempt any Two from the following.

a) Obtain Fourier series expansion of the function

$$f(x) = \begin{cases} \pi x, & 0 \le x \le 1 \\ \pi(2-x), & 1 \le x \le 2 \end{cases}$$ **[8]**

b) Find the fourier series expansion for $f(x) = x + \frac{x^2}{4}, -\pi \le x \le \pi$ and hence show that $\frac{\pi^2}{12} = 1 - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \ldots\ldots$ **[8]**

c) Expand $f(x) = e^x$ in a cosine series and sine series over (0, 1). **[8]**

**Q6)** Attempt any One from the following. **[16]**

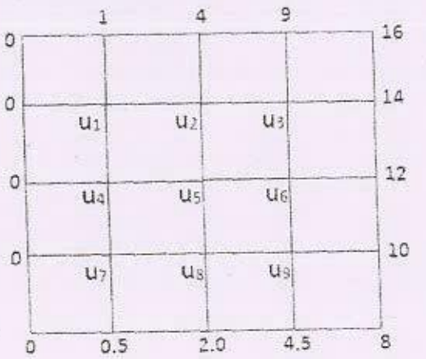
a) Solve the differential equation $\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2}$ subject to the following conditions:

i) $u$ is finite for all $t$

ii) $u = 0$ for $x = 0$ and $x = \pi$ for all $t$

iii) $u = \pi x - x^2$ for $t = 0$ between $x = 0$ and $x = \pi$.

b) Solve the Laplace equation $u_{xx} + u_{yy} = 0$ for the following square mesh with boundary values as shown in figure by Gauss-Siedal iterative method by performing three iterations.



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# S.E. (Mechanical) (Part-II) (Semester - IV)

## Examination, November - 2019

## THEORY OF MACHINES-I

## Sub. Code : 63363

**Day and Date : Tuesday, 19- 11 - 2019** **Total Marks : 100**

**Time : 2.30 p.m to 5.30 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Figures to the right indicate full marks.**
3) **Draw neat labeled sketches wherever necessary.**
4) **Assume if necessary suitable data & state clearely.**
5) **Use of Non-programmable calculator is permissed.**

**Q1)** a) What is inversion of mechanism? Explain inversions of double slider crank chain with neat sketches. **[8]**

OR

Explain condition of correct steering. Also differentiate Ackerman steering gear mechanism and Davis Steering gear mechanism. **[8]**

b) In a slider crank mechanism, the lengths of the crank and connecting rod are 200 mm and 800 mm respectively. Locate all I-centers of the mechanism for the position of the crank when it has turned 30° from the inner dead center. Also find the velocity of the slider and the angular velocity of the connecting rod if the crank rotates at 40 rad/s. **[8]**

**Q2)** In the mechanism shown in following figure, the crank OA rotates at 210 rpm clockwise. For the given configuration, determine the velocities and accelerations of sliders B,D and F. The various link lengths are,

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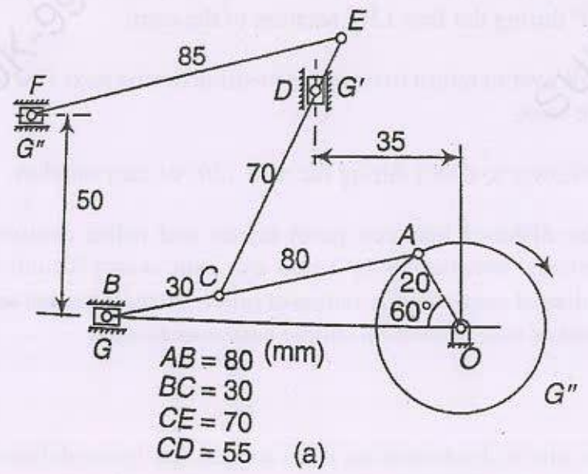
AB=80 mm, BC=30 mm, CD=55 mm and CE= 70 mm, OA= 20 mm, EF=85 mm. **[18]**




**Q3)** a) Derive the equation for force required to lift the load in square threaded screw jack using inclined plane theory. **[8]**

OR

a) Derive the equation for torque required to overcome the friction in collar pivot bearing using uniform wear theory. **[8]**

b) A 150 mm diameter valve, against which a steam pressure of 2 MN/m2 is acting, is closed by means of a square threaded screw 50 mm in external diameter with6 mm pitch. If the coefficient of friction is 0.12; find torque required to turn the handle. **[8]**

**Q4)** a) Draw the displacement, velocity and acceleration diagrams for a follower when it moves with simple harmonic motion and uniform acceleration and retardation. **[6]**

b) Draw a cam profile to drive an oscillating roller follower to the specifications given below:

i) Follower to move outwards through an angular displacement of 20° during the first 120° rotation of the cam;

ii) Follower to return to its initial position during next 120° rotation of the cam;

iii) Follower to dwell during the next 120° of cam rotation.

The distance between pivot centre and roller centre=120 mm; distance between pivot centre and cam axis=130 mm; minimum radius of cam=40 mm; radius of roller=10 mm; inward and outward strokes take place with simple harmonic motion. **[12]**

**Q5)** a) Explain what is dynamometer. What are different types of dynamometers? Explain any one in detail **[6]**

OR

a) Derive the equation of belt tensions on tight and slack side of belts $(T1/T2)=e^{\mu\theta}$ **[6]**

b) A belt drive transmits 8 Kw power from shaft rotating at 240 rpm to another shaft rotating at 160 rpm. The diameter of smaller pulley is 600 mm and the two shafts are 5m apart. The coefficient of friction is 0.25 if the maximum stress in belt is limited to 3 $N/mm^2$ and thickness of belt is 8 mm find the width of belt for open belt drive. **[10]**

**Q6)** a) Define and explain the following terms relating to governors: Stability, Sensitiveness, and Isochronism **[6]**

OR

a) Explain with sketch the working of centrifugal governor. How it differs from flywheel. **[6]**





b) In a spring loaded governor of the Hartnell type, the mass of each ball is 1 kg, length of vertical arm of the bell crank lever is 100 mm and that of the horizontal arm is 50 mm. The distance of fulcrum of each bell crank lever is 80 mm from the axis of rotation of the governor. the extreme radii of rotation of the balls are 75 mm and 112.5 mm. The maximum equilibrium speed is 5 per cent greater than the minimum equilibrium speed which is 360 r.p.m. Find, neglecting obliquity of arms, initial compression of the spring and equilibrium speed corresponding to the radius ofrotation of 100 mm. **[10]**

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# S.E. (Mech.) (Semester - IV) Examination, November - 2019
## APPLIED NUMERICAL METHODS
### Sub. Code : 63360

**Day and Date : Wednesday, 13 - 11 - 2019** **Total Marks : 100**
**Time : 2.30 p.m. to 5.30 p.m.**

**Instructions :**
1) **All questions are compulsory.**
2) **Use of non programmable calculator is allowed.**
3) **Assume additional data if required and mention it clearly.**

**Q1)** Solve any two: **[16]**

a) Perform two iterations of Newton Raphson Method to Solve:

$x^2 + xy + y^2 = 7$, $x^3 + y^3 = 9$

Take initial approximations $X_0 = 1.5$, $Y_0 = 0.5$.

b) Define errors? Explain Approximation error with an example.

c) Find root of equation $x^3 - 4x - 9 = 0$ using bisection method, correct to three decimal places.

**Q2)** Solve any two: **[16]**

a) Solve following equations by Gauss Seidal method.

$2x + y + 6z = 9$, $8x + 3y + 2z = 13$, $x + 5y + z = 7$.

b) Solve following equations using LU-decomposition method

$10x + y + 2z = 13$, $3x + 10y + z = 14$, $2x + 3y + 10z = 15$.

c) Solve by Jacobi Iteration Method

$8x - 3y + 2z = 20$, $6x + 3y + 12z = 35$, $4x + 11 - z = 33$

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**Q3)** Solve any three: **[18]**

a) What are the applications of binomial distribution and normal distribution.

b) Find Mean and Median

| Marks | 0-10 | 10-20 | 20-30 | 30-40 | 40-50 | 50-60 |
|---|---|---|---|---|---|---|
| No. of Students | 12 | 18 | 27 | 20 | 17 | 6 |

c) Find missing term in the following table using Lagrange's interpolation formula.

| X | 0 | 1 | 2 | 3 | 4 |
|---|---|---|---|---|---|
| Y | 1 | 3 | ? | 31 | 81 |

d) Find f(x) as a polynomial in x and f(6) for the following data by Newton's divided difference formula

| $x$ | 1 | 2 | 7 | 8 |
|---|---|---|---|---|
| $f(x)$ | 1 | 5 | 5 | 4 |

**Q4)** Solve any three: **[3×6=18]**

a) Evaluate the integral $I = \int_0^{\pi} \sin x \, dx$ using Trapezoidal and Simpsons 1/3rd Rule.

Take $n = 10$.

b) Use Romberg's method to evaluate $\int_0^1 \frac{x}{\sin x} dx$ take h = 0.5, 0.25, and 0.125.

c) Evaluate $\int_0^{\pi/2} (\sin x) dx$ by two point Gaussian Quadrature formula.

d) Find the value of cos(1.74) from the following table

| $x$ : | 1.7 | 1.74 | 1.78 | 1.82 | 1.86 |
|---|---|---|---|---|---|
| Sin($x$): | 0.9916 | 0.9857 | 0.9781 | 0.9691 | 0.9584 |

**Q5)** Solve any three **[3×6=18]**

a) Solve

$\frac{dy}{dx} = x^2 + y^2$; given $y(0) = 1$. Obtain the values of $y(0.1)$ using Picard's method.

b) Apply the fourth order Runge Kutta method to find y(0.2) given

$\frac{dy}{dx} = y + x$; $y(0) = 1$ take $h = 0.1$

c) Find $y(0.2)$ and $y(0.1)$ by Euler's Method,

if $\frac{dy}{dx} = x^2 + y^2$; $y(0) = 1$

d) Find the largest Eigen value and the corresponding Eigen vectors by power method.

$$\begin{bmatrix} 8 & -4 \\ 2 & 2 \end{bmatrix}$$

**Q6)** a) Solve $u_{xx} + u_{yy} = 0$ in the square region bounded by $x = 0$, $x = 4$, $y = 0$, $y = 4$ and with boundary conditions: **[10]**

$u(0, y) = 0$

$u(4, y) = 12 + y$

$u(x, 0) = 3x$

$u(x, 4) = x^2$

take $\Delta x = 1$, $\Delta y = 1$. Perform two iterations

b) Classify the following partial differential equations $U_{xx} = 8U_x + U_y$. **[4]**